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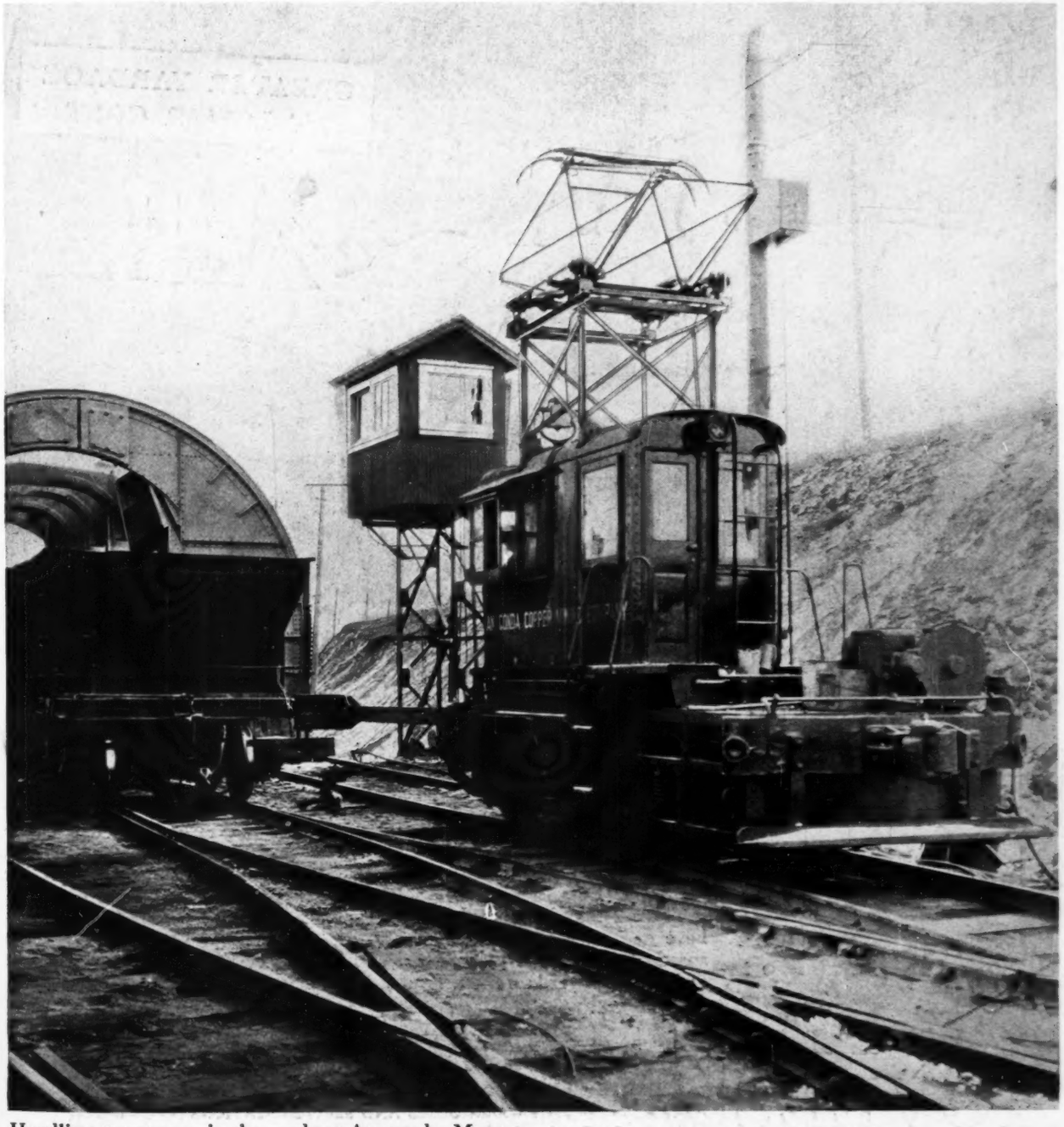

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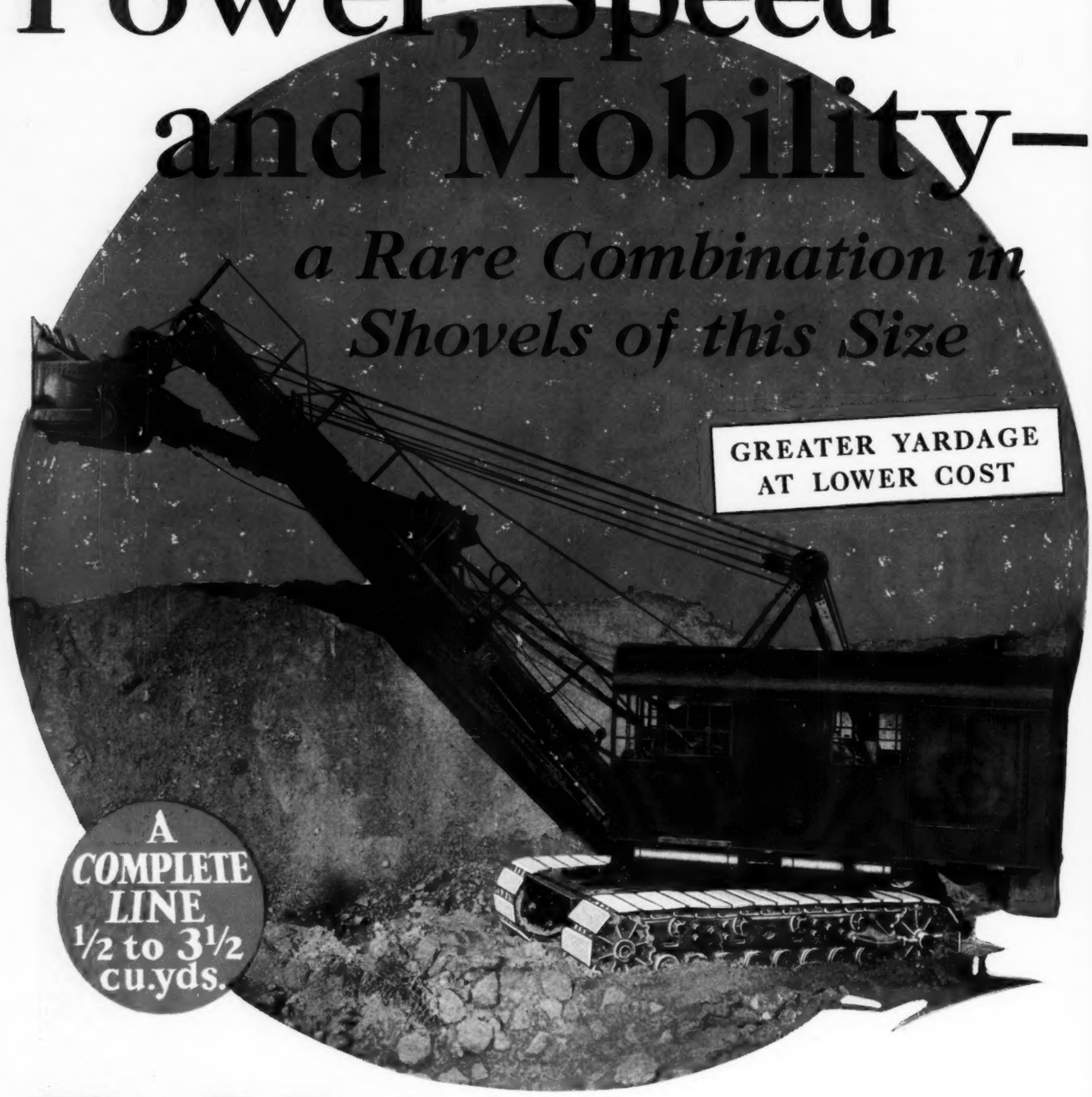

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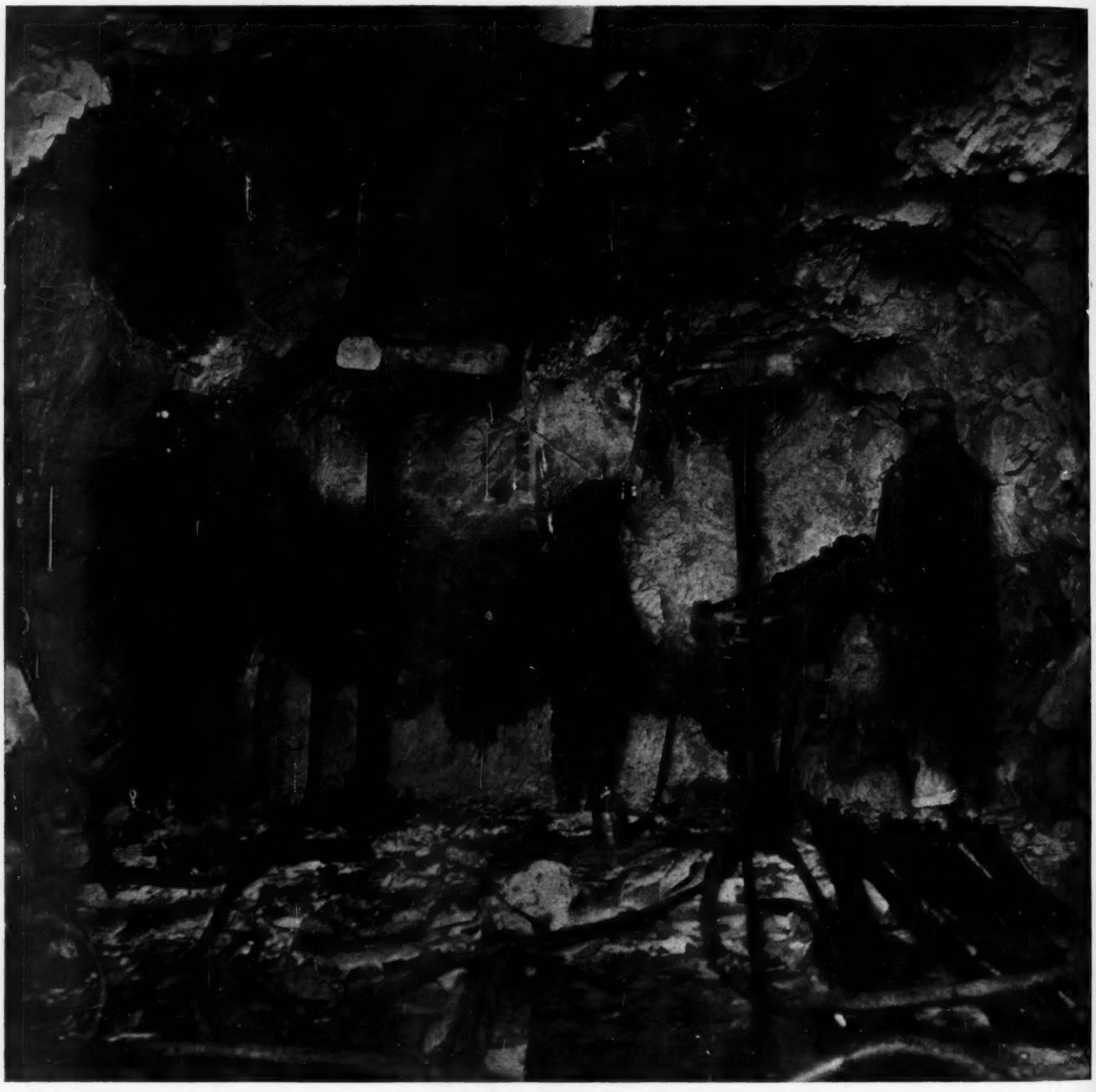

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Engineering and Mining Journal

February 23, 1931 A. W. ALLEN, *Editor* Vol. 131—No. 4

To Aid the Producers and Users of Silver

CAUSE FOR SATISFACTION is seen in the stimulation of thought among experts on both sides of the Atlantic in recent months on the subject of the rehabilitation of silver. One of the earliest contributory causes of the present deplorable situation—the debasement of Great Britain's silver currency in 1920—is being discussed in England, and demands are being made there for a reversal to the use of sterling silver, which would absorb a considerable quantity of the metal at a comparatively small cost to the nation.

A commission of American economic experts recommended, early in 1930, the gold standard for China. This supplemented the attempt to put India on a gold standard. Large sales of silver occurred, to the detriment of silver-standard nations. These influences, coupled with the protectionist policy of the United States, have put China on the defensive, with the result that she has been forced to plan for a greater measure of economic independence. The success of her endeavors in the establishment of domestic industries, and in the restriction of imports, is causing grave concern to the two great English-speaking nations. An appreciation in the price of silver would be of advantage to all concerned, especially to China; but the idea must be abandoned that such a reform is proposed either by Great Britain or the United States, or by both, solely as an act of altruism. As a writer in *The Times*, of London, recently averred: "The years 1929 and 1930 were years of widespread unrest and internal disorder in China; but, notwithstanding these adverse conditions, we find activity and expansion in the same branches of industry in which stagnation and unemployment were conspicuous in this country."

Among the many proposals recently made to remedy the present situation, the suggestions of Mr. Francis H. Brownell, chairman of the board of American Smelting & Refining, are attracting major attention. Mr. Brownell's plan calls for the stabilization of the price of silver, but at no fixed ratio to gold. It involves an intergovernment understanding that no nation will sell any of its silver stock for less than the fixed price; that when silver is below that price every government will buy as much as it is authorized by its own statutes, to purchase for subsidiary coinage; and that, when the price of silver has reached a certain point above the fixed price, every government shall have the privilege of selling from its stock. This plan merits the co-operation of all interested governments.

When a commodity reaches an extremely low price, and when supplies mount, one expects the application of the ordinary remedy—a cut in production. Silver is a law unto itself in this respect, however, for it is largely a byproduct, and its price is usually not a determining factor in the production of those metals with which it is usually associated. In 1930, therefore, the world produced about 244,000,000 ounces at the average price of only 38 cents an ounce, compared with 261,000,000 ounces in 1929 at 53 cents an ounce. So attention must be paid to proposals for increasing the buying of silver, and for the prevention of dumping of stocks, as the most promising opportunities for improving the silver market. Mr. Brownell's suggestions are evidently based on an acceptance and realization of this point of view. Furthermore, his plan is concerned only with the non-industrial use of silver—as a standard of value rather than as a metal of commercial use. Here too, his plan has a firm foundation, for, of the 315,000,000 ounces of silver consumed by the world in 1930, probably less than one-quarter went into the arts and industries.

Again, however, one may ask the pertinent question: are silver producers still content to believe that no more of their product can be used in the arts and industries when the price is low than when it is high. Silver used in industry goes chiefly into sterling silverware, silver-plated ware, photographic film and paper, and into the chemical industry. All of these outlets used less silver in 1930, when the price averaged 38 cents, than they did in 1929, when it was 53 cents. This is a discouraging fact. Are not the silver producers overlooking the possibility of greatly widening this market?

As was pointed out in these columns a year ago, sterling silverware is not used to an extent indicated as logical by a common-sense survey. A demand is not being met, because of the prohibitive cost to the consumer, a cost out of all proportion to the price of the metal used in manufacture. Householders and gift givers in large numbers would purchase sterling silverware if prices were reasonable—if the expense bore some logical relation to the market price of the raw material. One solution of the problem then suggested, which has even greater force today, is for a few of the more progressive silver producers to follow their product through to the ultimate consumer—to apply engineering common sense to the economic problems of manufacture and distribution to Mr. Average Citizen. Research, careful planning, a necessary investment in fabricating facilities, and judicious advertising might bring a small but welcome profit to such a subsidiary enterprise, stem the further demoralization of an important mining industry, and stimulate a confidence in the future of silver that is sadly lacking at present.

We again commend the idea to silver producers with the full knowledge that the industrial use of silver is never likely to compare with the consumption of the metal based on its recognition as a standard of value, but with the belief that such a potential outlet might be made of sufficient importance to be a real aid in the present emergency. Whether the popularizing of sterling

silverware for household use would restrict its appeal as a precious metal among the select few who can afford prevailing prices remains to be seen. The loss, if any, *Engineering and Mining Journal* believes, would be more than offset by the stimulation of employment and the greater turnover at a price more consonant with market quotations of the metal.

Gold Production Increases in California

PRELIMINARY data shows a gain of $506,897 in California gold production for 1930 compared to 1929, the respective figures being $9,033,600 and $8,526,703. A considerable decline of gold-dredger production occurred in 1930, so that almost a million dollars can be credited to increased production from new, reopened, and old mining properties. Ten years ago, 1921, gold production was $14,670,346. The output declined slowly until 1926, after which the decline was more rapid, chiefly because of less activity in dredging.

The upturn might be considered fortuitous but for the fact that a greater interest is being shown in gold mining and more determined efforts are being made to find new properties and to make the older ones more profitable. Lower commodity prices are of advantage; but better engineering, better management, and more skillful operation will undoubtedly be greater factors in rehabilitating the industry.

Increased activity in prospecting the well-known mining areas may be expected to disclose untouched deposits. The availability of excellent mechanical equipment makes conditions more favorable for rapid and economical exploration. California is only one of several Western states that afford opportunity for gold mining. Nevada, Arizona, Montana, and Colorado should also offer more promise now than heretofore.

An Interesting Hobby for Mining Engineers

PERUSAL of the December issue of *Rocks and Minerals,* and of the recent article in *Collier's* entitled "Be Your Own Gem Expert," brings to mind the interest that attaches to the science of mineralogy, particularly the mineralogy of precious and semi-precious stones. The knowledge of mineralogy possessed by most mining engineers decreases in direct proportion to the time passed since they wore cap and gown. Few with a background of operating or consulting experience could secure a passing mark in spotting the minerals in even an elementary collection, after twenty years of developing new stoping methods or finding the best flotation reagent. Pyrite, galena, chalcopyrite, quartz, granite, schist: these are fairly familiar; but how many are now on speaking acquaintance with old favorites such as psilomelane, wolframite, zincite; epidote, andalusite, and wad? How many, except those who perhaps invested in some costume jewelry for a Christmas present, know the difference between chrysoprase, carnelian, and sardonyx, or can distinguish them from their glass imitations?

What more appropriate hobby, or more interesting, can a mining engineer have than a familiarity with mineralogical distinctions? It is one that he may cultivate to the point where he may rightly be considered an expert, and without great expenditure. A collection of 35 different rocks and minerals can be obtained for a dollar, or for no expense at all except a little trouble; and if one has access to a good deposit of any one variety, doubtless a good mineral collection could be made merely by trading with other kindred souls. Even if one has a desire to specialize in gem stones, there are few whose value, in the natural state, puts them beyond the reach of the collector. One need not insist on the perfection or the size of those which Dr. George F. Kunz pridefully exhibits at Tiffany's.

The friends of a mining engineer naturally expect him accurately to name every unusual stone picked up in the pasture or back yard, every pretty pebble on the beach. Why should one have to make the evasive reply that it is apparently a weathered specimen of sedimentary or igneous material?

Ultimate Economy in Plant Modernization

THOSE who are determined to reduce expenses should remember that the future is coming, with its renewed demand for ore and metal. If the plant is obsolescent and run down, the time is opportune for modernization and repair. Machinery and supplies are obtainable at unusually favorable terms and prices. Labor is abundant. The same job next year will probably cost much more. If operating expenses must be cut, every machine or device said to permit economies should receive attention. Installation of such a device, the cost to be distributed over several years, should precede any move to discharge employees. Thus the maximum employment possible at the moment, and lower operating costs for the future, will be insured.

Modernization with respect to equipment means the use of machinery and appliances that make possible the lowest operating cost, including that of maintenance. If an old-established, long-tried device will do this, it is strictly modern, despite its age. But will it? For instance, are the cans or "tubs" of the Tri-State zinc district really better than cars for transporting and hoisting ore? Some say they are. Excellent tonnage records have been made with them. Handled snappily as they are by trammer, "tub hooker," and "hoisterman," they afford simpler tramming-hoisting equipment than the car-cage or car-skip combination that some would substitute, and in cases have substituted, for them. But perhaps the possibilities of cage or skip hoisting have not been sufficiently studied by the district's operators. Underground belt conveying of ore from stope to shaft pocket, in conjunction with skip hoisting, might give lower costs. Such a system of ore transport underground, used in many metal mines abroad, has been almost completely ignored by the operator in this country outside of the coal industry.

Automatic control of operation offers many opportunities, now neglected, for decreasing cost. An outstanding example is found in pumping practice. Centrifugal pumping, by multi-stage as well as single-stage units, is widely used in United States metal mines and mills today. Yet the obvious and proved advantages of controlling such pumping automatically seem to be ignored, although various coal-mining companies have been benefiting from them for many years. Just why this is so is hard to understand.

Automatic control, in varying degree, has also been developed for power-generating and converting equipment, for maintaining furnace temperatures, for hoisting, surface transfer, switching, signaling, lubrication, heat-treating of drill steel, remote operation of plant valves and other equipment—permitting economies in each instance. Such control often saves the equipment from abuse to which it might otherwise be subject. At a slight increase in plant investment, it offers mining companies the opportunity to cut operating costs in one or more of several departments.

Abnormal Underground Conditions Prompt New Technique

A PAPER of interest to mining engineers concerned with control of ground movement was recently published in a *Bulletin* of the Institution of Mining and Metallurgy. The author, Mr. P. J. Crowle, dealt with mining conditions in the Kolar gold field, South India, restricting his account principally to the Ooregum mine.

Difficulties of operation include severe underground temperatures, the depth of the workings, the prevalence of rock-bursts, and persistent wall movements. About thirteen thousand earth shocks per annum have been recorded in the vicinity of the mines during the last eighteen years. Mr. Crowle classifies nine per cent as "heavy." The report indicates continual readjustment by increasing stress, followed by fracturing. Three pronounced zones of lines of weakness exist in the otherwise solid and massive rocks. Bursts were unknown in the early shallow workings, but at depths of 6,000 feet the compressive stress is over three tons per square inch. Movements of walls are caused by static and dynamic rock pressures, Mr. Crowle states, induced by the removal of support. Below the 5,000-ft. horizon, bursting of the wall rock began when about 60 per cent of the vein had been extracted from a given area.

Several corrective methods were tried, the one finally selected involving the support of 40 per cent of the stope area by rock-pack walls, running from level to level in lines paralleling the dip and spaced twelve feet apart, their dimension along the strike being eight to ten feet. The material used is granite quarried on the surface, the rock blocks being roughly squared. By using small or large-sized pieces, the amount of voids can be varied. Compression amounts to ten per cent where the granite packs are under steady pressure. After a severe burst in a heavily weighted area, it may be sixteen to twenty-three per cent.

This unusual method of supporting stopes has resulted in controlled wall movement. The cost has been moderate. It offers another example of the resourcefulness of the miner when confronted by new conditions.

Scientific Methods of Control Are Needed

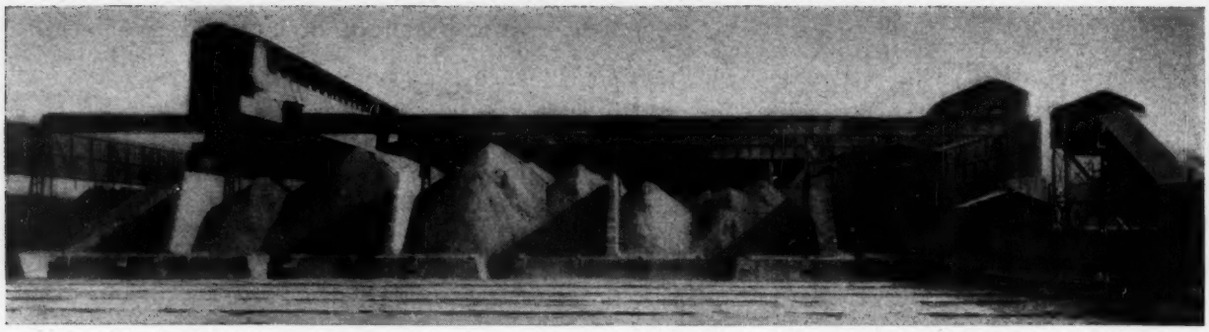
INTRODUCTION of scientific methods of control have made such strides during the last few years that some observers have been apprehensive that the development has been too rapid, that it is partly responsible for the present economic maladjustment, with its concomitants of overproduction and unemployment. However true the assertion, a correction of existing evils must come by improvement in method rather than by sacrificing efficiency and lowering standards.

Metallurgy still shows many examples of obsolete practice to which age and tradition have given an undeserved life. Chemical engineering, on the other hand, a more recent development, with many points in common with metallurgy, has a more modern appearance. It gives more evidence of the application of scientific methods. The chemist has borrowed machinery and equipment from the metallurgist; but in the construction of apparatus and in the technique of control he has displayed independence and creative ability, giving the metallurgist ample opportunity to do some borrowing in return.

Too many metallurgical furnaces are run without the use of pyrometers. Determination of an important factor, temperature, is left to the human eye, which introduces the element of chance. Preparation of furnace charges is too often accomplished by the "hit-and-try" method, without taking advantage of the many excellent and reliable devices for weighing moving material, on a belt conveyor or as discharged from a bin. The rate of flow of liquids—steam, air, or gas—is also easily determined, and even corrosive liquids offer no difficulty in this respect. An adequate number of meters and recording instruments at strategic points is a valuable aid in the supervision of a plant.

Demands for uniform quality and high purity have been met with excellent response in the metal industry during recent years. Metals of a purity formerly possessed only by laboratory specimens are now produced commercially. Spectrographic methods of analyses have been a valuable aid in this development; minute amounts of impurities may now be determined in a few hours, whereas formerly such determinations required several days. Another important development in analytical control that is coming into prominence is electrothermic titration—a procedure that probably has made more progress in Europe than in the United States. Like spectrography, it has the advantage of giving reliable results, even where only minute samples are available. The personal element is almost completely eliminated, as all important observations are confined to simple readings of instruments, permitting no mistake except by gross or wilful negligence. This coincides with the modern trend of developing rapid and reliable tests—so simple and easy to perform that field determinations may be made by operators or foremen to check and control important intermediate steps of a process.

Modern metallurgy, with its distinct leanings toward physics and physical chemistry, is making strong demands upon its followers. Although this may be the age of the specialist, the value of a broad fundamental knowledge must not be lost sight of. The time for specializing is not reached until such a foundation has been attained.



ORE BEDDING

Description of methods devised and equipment adopted for the averaging and storage of ore at the smelter of the Phelps Dodge Corporation at Douglas, Ariz., resulting in improved efficiency and reduced operating costs

David Cole

Consulting Engineer, El Paso, Tex., U.S.A.

THE new ore-bedding system at the Copper Queen plant of the Phelps Dodge Corporation, at Douglas, Ariz., is now in operation. This plant, which is of my own design, is especially adapted to local conditions and differs in several respects from the usual Messiter system of bedding and reclaiming ore, so generally used in the Southwest. In this new design the principal features are a digging elevator, for which a trench makes a continuous boot; and the fact that one set of incoming conveyors serves all of the stalls or beds, and one set of outgoing conveyors empties all of them, instead of one set of incoming and one set of outgoing conveyors for each bed, as is the usual practice. The plant has five stalls, as shown in the illustrations, and 900 ft. of 24-in. belt conveyor, operated at 300 ft. per minute, is used, instead of the 2,700 ft. of conveyor that would have to be installed with the old system.

The rakes of the reclaiming machine were intended to operate at an angle greater than the angle of repose, and are adjustable, as in the former system, but as the new machine cleans the entire area between the walls of the beds, the rake cannot be reciprocated crosswise. Furthermore, the area of bed section worked upon is much greater, which would require a much larger harrow, so this member is now made in four parts designed to move up and down, alternately, in balance—two up and two down.

At the bottom of the inclined face of the pile is a set of plows or scrapers whose operation is as usual except that both deliver from their respective sides to the central trench. These are especially designed for long life, being made of manganese steel throughout, using the same chain and flights that have proved so successful in the heavy ore feeders designed by Corey Brayton, of the American Manganese Steel Company. The digging elevator, which is really the heart of the machine, is also constructed entirely of manganese steel. The digging buckets are 30 in. wide, hold 2 cu.ft. each, and travel at from 40 to 60 ft. per minute. Manganese-steel links are used, similar to those on the very successful new manganese steel feeder for steam-shovel ore at Ajo. They have renewable manganese-steel bushings and pins, "manganese on manganese," no lubrication being required or permitted. The flights and buckets are cast integrally, they overlap, and little leakage occurs between the buckets. Proper flexibility of speed and capacity is assured by the use of variable-speed, direct-current motors throughout.

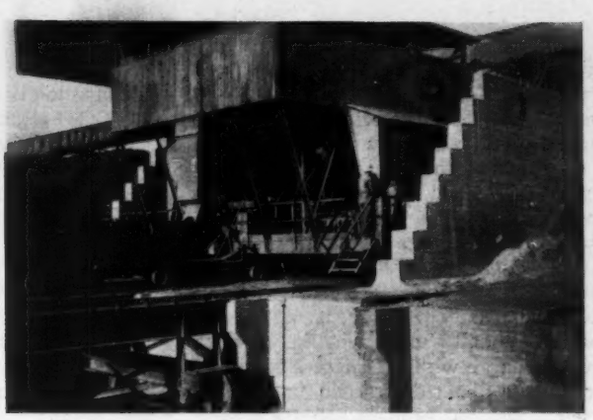
The reclaimer progresses forward less than 6 ft. per hour when handling 300 tons per hour. It has a reverse speed of 30 ft. per minute for backing out and re-entering a new bed. Following the reclaimer, and coupled to it, is a shuttle conveyor for receiving and taking away the reclaimed ore. The shuttle structure is carried upon its transfer table when the reclaimer is out of the beds. This transfer table has its own transverse tracks in the transfer area. Directly over the belt that takes the reclaimed ore to the furnaces is a tripper fixed to the transfer table, and the shuttle conveyor belt is threaded through this fixed tripper, which is always in position to feed the take-away belt, installed in the transverse trench underneath.

A suitable independent transfer table is provided for the reclaimer itself, and, after having its "trailer" uncoupled is moved from bed to bed at will, under its own power. The shuttle conveyor transfer table also has its own power and is moved independently to position and is then recoupled on to the reclaimer.

The stalls have walls 16 ft. high, heavily reinforced and with wide inverted T-shaped bases, making them stable both ways. They are 2 ft. thick at the bottom and 10 in. at the top. The six walls are parallel, at 43-ft. centers, forming five stalls, each 200 ft. long (of net bed), and each bed has a capacity of 11,500 tons of ore and concentrates (average weight of 125 lb. to the cubic foot). One end of the stall is closed by a dirt fill, which supports the walls at their end. This is cheap and at the same time affords the proper reclaiming slope on the inside.

The two plate girder bridges crossing the beds are supported on piers integral with the walls, these bridges carrying the mobile spreader conveyor bridge, which has its own traction machinery, like a crane. This structure carries the spreading conveyor to any part of the area occupied by the five beds. Its tripper is electrically operated and is automatic between limit switches for spreading the ore in the beds. The incoming end of this bridge is connected to the tripper of the incoming feed belt through a continuous opening in the side of the incoming conveyor housing; and, in order to turn the stream on to the spreading belt without occupying

An emptied stall ready for refilling



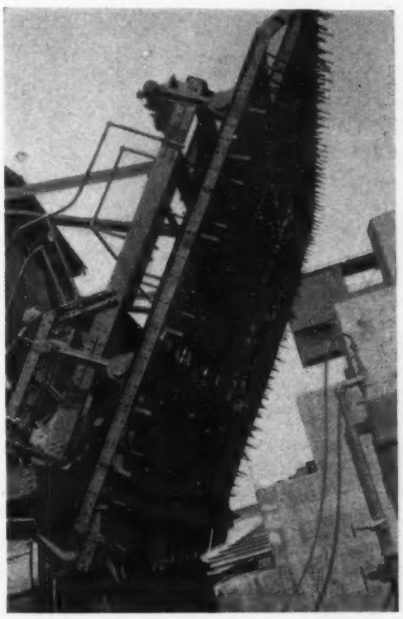
Looking at the reclaimer from the side

too much room, also without making the primary conveyor housing too large, and to facilitate getting any sticky stuff across, a short cross belt on the tripper is used. With this hook-up the feed need not be shut off clear back to the crushing plant, when the spreading bridge is moved.

A corrugated-iron windbreak has been erected on three sides of the structure, and a skirt board on the spreading bridge reaches down to the plane of the top barrier.

About 52 per cent of the "charge" for the beds consists of run-of-mine oxide and other ore from the Bisbee stopes and some custom ore, all crushed to pass screens which give substantially a ¼-in. undersize; in this is a large percentage of "limestone" ore containing very sticky clay. "Silica," from Sacramento hill stopes, is crushed in separate lots, the fines are screened out to divert a proper oversize to bins for converter use, and the undersize, which then packs like moulders' sand, goes to the beds. About 32 per cent of the bed charge is flotation concentrates (with 10 per cent moisture) from the Sacramento concentrator and from the Moctezuma mill at Nacozari. Also included are some cementation copper slime and the usual percentage of secondaries such as crushed slag and other smelting reverts.

The first beds filled were improperly laid, for the trenches of the bedding stalls were inadvertently filled with the fine silica sand just mentioned. Above this were laid the other materials as received. More than the usual time between the filling of the beds and the starting of the reclaiming operations elapsed, so these first beds became consolidated to a greater extent than usual. Enough chemical action occurred so that the interiors of these beds were quite warm, but there was no cementation or chemical consolidation.

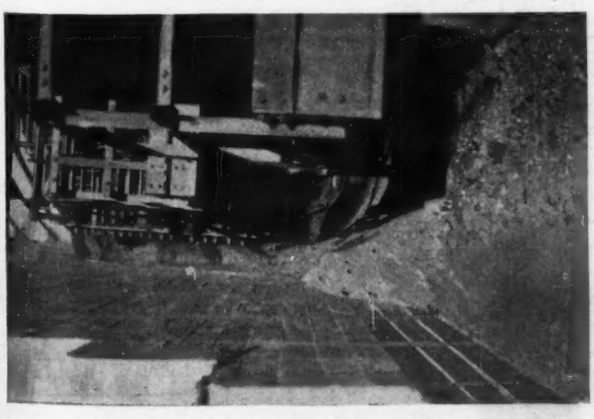


The toothed harrow first installed

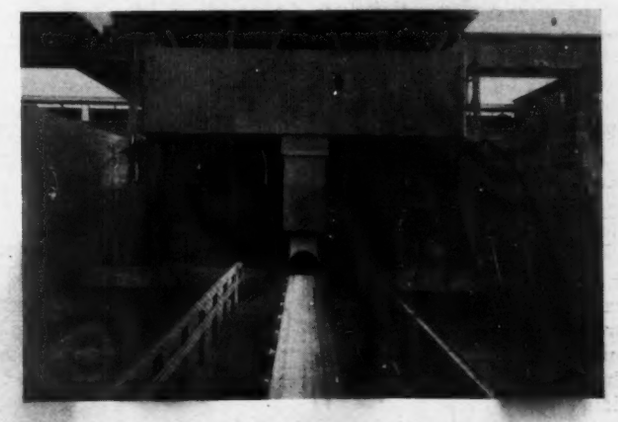
Provision had been made in the design of the rakes of the reclaimer for varying the angle from 50 up to 60 deg. from the horizontal, so as to have latitude in which to find the best angle to use. It was found in practice, however, that the vertical face would be stable, and that the rakes worked best when operated on the steepest angle that had been provided for.

Following standard practice, the harrows had been provided with a great number of teeth, as shown in the illustrations. To the great surprise of everybody, these dug themselves in, clear to the hilt, without causing caving of the surface. This digging-in built up resistance to the operating mechanism, greatly overloading it. So the harrow teeth had to be abandoned, and blades, arranged to overlap in their travel, were substituted. These were 2-in. angles, with edges reinforced against wear by electrically welding a bead on them, using manganese-steel welding rod. This was regarded as an emergency expedient against wear, probably to last a few beds only, but the edges are found in practice to become only good and bright, and promise to have a very satisfactory life. These angle-knives are disposed so as to present both edges properly to cut the face.

The packy silica in the trenches of the initial fillings prevented the caving of the material below the raked area, an adverse condition that had to be fought until these beds were emptied.



Side view of reclaimer at work in a stall



As the reclaimer looks from the rear

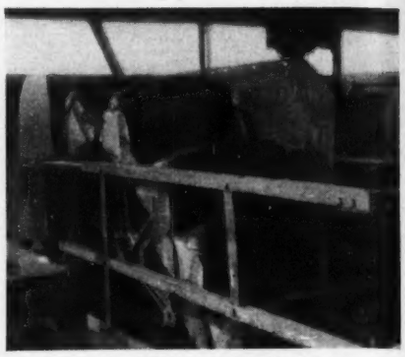
The trenches are now filled with the crushed slag secondaries, forming a gravel-like charge, as was originally intended. This material will not consolidate, and works as anticipated.

Because of the sticky nature of the material handled, the elevator dribbles more, after passing the discharge chute, than was anticipated, and this dribble sometimes nearly fills the trench in the rear of the advancing elevator. Since it requires only 4 per cent of the bed capacity to fill the trench, the elevator can discharge with 96 per cent efficiency and still dribble the trench full behind itself. This has brought about a change in the retreating speed of the reclaimer to allow the machine to move out at a speed that will take up from the trench its regular capacity rate of this backfilling, thus keeping the delivery to the furnace bins as constant when backing out as it is when reclaiming from the face. Since the dribble is a thorough mix, representing a cross-section of the bed, no segregation or loss of time results.

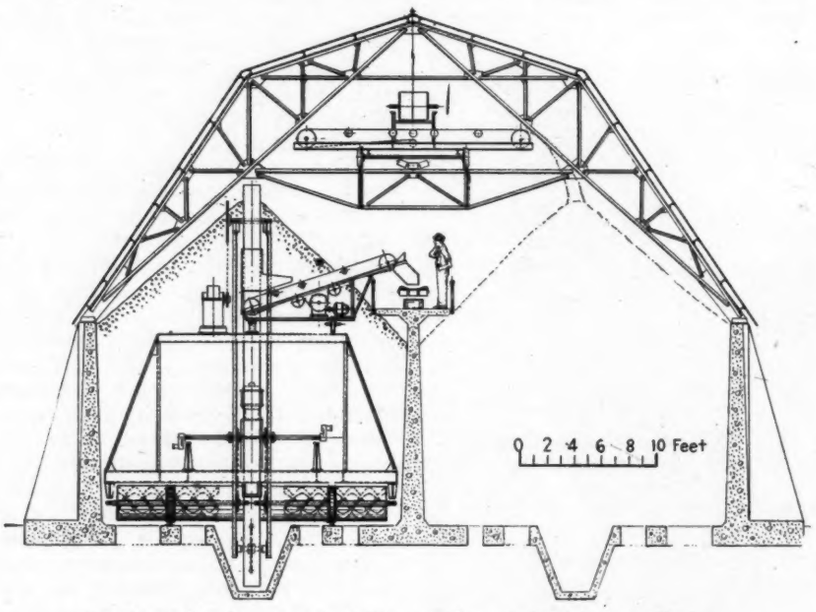
The sticky clay, the almost as sticky flotation concentrate, and the unusually packy siliceous material, have been, so far, in such large amount, that the beds will not fall from any tooth-harrowing operation such as has been the practice in this class of reclaiming. Doubling the usual number of harrow points did not improve the situation any. The blade system, which cuts substantially the whole face, must of course have clearance between the reciprocating knife ends. This clearance is about 2 in., and it is not uncommon for this narrow uncut area to stand out until it protrudes from the face of the pile for more than a foot, like a fin, which shows the extraordinary degree of consolidation.

As to cost, this plant required approximately 327 tons of structural steel, 302 tons of reinforcing steel, 3,950 cu.yd. of concrete 12,260 cu.yd. of excavation and backfilling, 900 ft. of 24-in. conveyor, 6,000 ft. of 100-lb. rail, and 1,600 ft. of 40-lb. rail. Its cost was $5.50 per ton of storage room. The plant, including the transfer area, occupies ground space measuring 530x 220 ft.

One bedding operator, working eight hours in consonance with the crushing and sampling plant, will bed the ore. Two reclaimer operators, with a helper each, working in consonance with the needs of the roasters, are sufficient to take the ore out. The minimum tonnage to be handled is assumed to be 2,000 tons per day. This could be greatly exceeded by merely digging faster and without any changes or additions to the plant. The total power, labor, and current repair cost on the 2,000-ton basis should be less than $50 per day for bedding and reclaiming, not including expenses for crushing, sampling, and conveying.



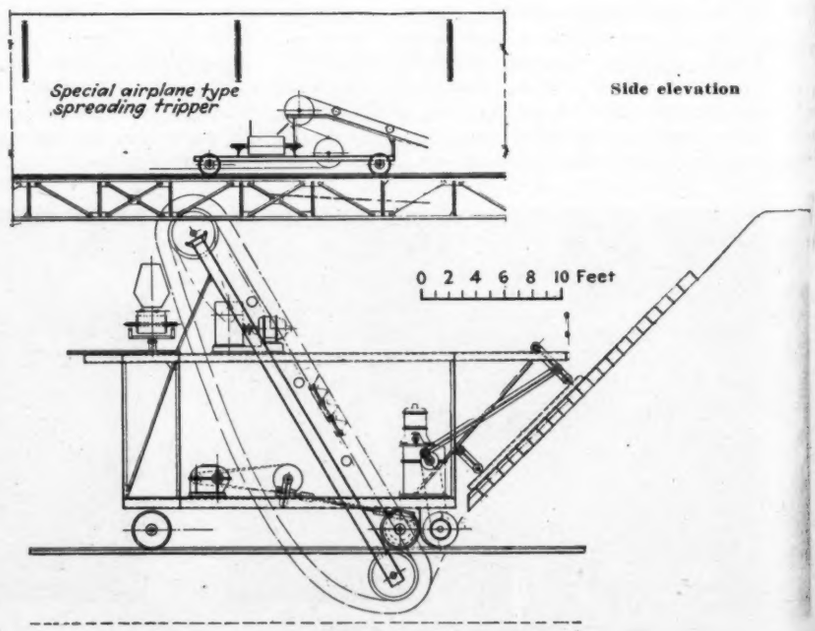
Head of manganese-steel elevator on reclaimer



Rear end elevation (rakes and traversing mechanism not shown)

Assuming as reasonable that all the manganese-steel digging and scraping lines, also all the conveyor belts, gears, chutes, lumber and painting, would have to be replaced in seven years; also an annual write-off of 10 per cent of the cost of the motor and starting equipment, and 10 per cent of the cost of the transfer tables, the aggregate items would amount to about $75,000, to be divided by the 5,000,000 minimum seven-year tonnage, a charge of 1.5c. or less per ton. The new system operates at decreased cost compared with the old handling methods, and results in an improvement in furnace speed and general metallurgical efficiency, but it will take a year of operation to mature the interesting details, including metallurgical advantages and detailed operation cost figures.

For northern climates this type of plant would be covered and be made weather-proof. The walls could be hol-



Side elevation

low and be steam-heated, thus keeping the mass of ore from freezing.

With modifications, this type of storage could be used to advantage in large milling operations; in fact, we have been building our storage bins for feeding milling plants upside down, wherein the pile handled is broad on top and narrow and constricted at the bottom, a system resulting in troublesome segregation of sizes in the process of filling, and in equally troublesome funneling in the draw-out, which is generally through an absurdly inadequate number of discharge openings. Such a type of draw-out also exaggerates the segregation of sizes, causing much variation between shifts in feed rate, in the facility of grinding, and in the metal content of the ore. Furthermore, the holding of this great stored supply upon columns, makes an *expensive* bin, for it must be built that way solely to get these habitual draw-off devices under it, usually costing more than would twin bedding arrangement of equal capacity.

By using the method of bedding and reclaiming herewith described, securing a mill feed of perfectly uniform crushing quality and metallic content (thereby doing away with the millmen's variable-quality alibi), less capital expenditure and cheaper handling results, and much better metallurgical operation is attained.

Summarizing, in this scheme of storage, three self-sustaining walls support covered twin beds which are served by a single conveyor for in-and-out transportation, with a single reclaimer transferable from one to the other of the beds as needed. The reclaimer is built symmetrically about the vertical center line and its cross delivery conveyor is a carriage, moving in a circle so that it will deliver to the take-away belt from either side. The storage is 100 per cent emptied by the reclaimer and it is a uniform mix.

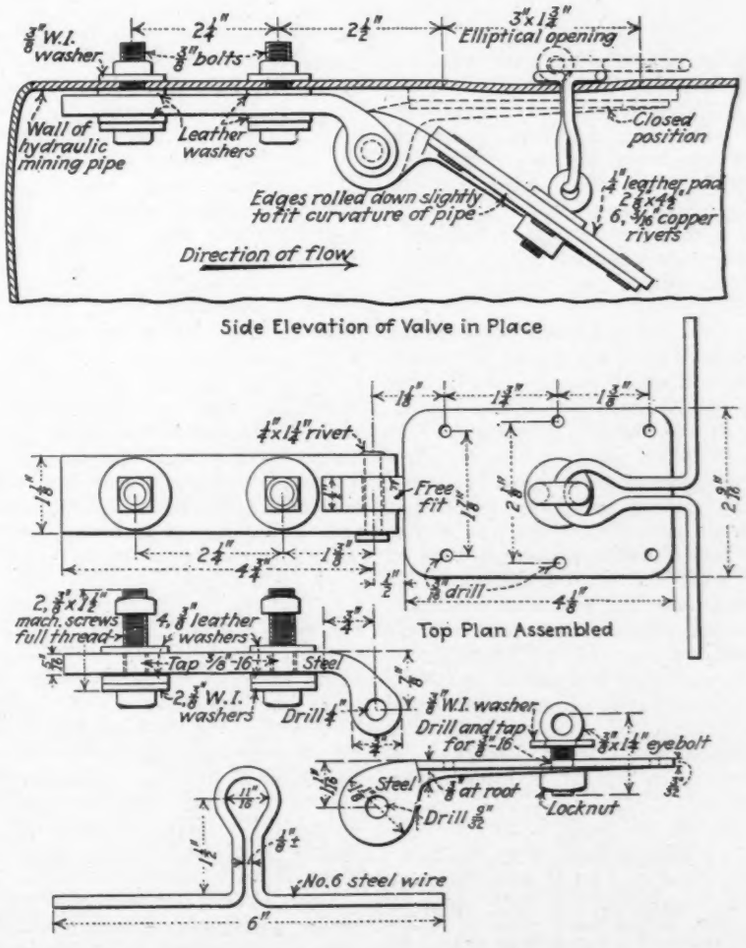
Air-vent Valve for Hydraulic Piping

THE venting of hydraulic mining pipe has always offered a problem to engineers. On account of the high velocities employed, and the consequent danger of collapsing the pipe line in the sections at lower elevations, air valves are needed at every crest in the line. At these points the profile of the pipe line approaches the hydraulic gradient, and failure occurs when a break in the line allows the gradient to fall below the profile of the pipe line, producing a vacuum.

The Salyer Consolidated Mines Company, in Trinity County, Calif., has overcome this hazard by employing a novel flap valve, writes John R. Jahn, civil engineer, San Francisco, Calif. This valve, details of which are shown in the accompanying illustration, was developed at the La Grange mine, near Weaverville, Calif., and was introduced at the Salyer property by B. R. Brown. It can be made in any blacksmith shop. The Salyer company has been quoted a price of $4.25 per unit by a general shop.

Inasmuch as they are inexpensive, the valves are installed at intervals of 100 ft. They open the instant a break occurs. A second important function is the venting of air pockets in the line. In the assembled views shown in the accompanying illustration, the action of the valve is apparent. As the pipe fills, the vent valve allows the air to escape. As soon as the water strikes the back of the valve, it closes tightly and the bail drops down on the outside of the pipe. The leather facing on the flap fits the curve of the pipe, and, if it is oiled when new and soft, it will serve for several years without attention.

In installing the valve an oblong or elliptical hole, 1¾ in. wide by 3 in. long, is first cut along the top of the pipe, and the inside edges are trimmed clean. Two holes are then drilled for the ⅜-in. bolts, at 2½ in. and 4¾ in. from the edge of the hole. Strings, which are lowered through these holes and fished out through the large hole, are fastened to the ends of the ⅜-in. machine screws. The bail on the flap is now sprung open and taken off, and the valve inserted endwise into the oblong hole. The bolts are pulled through their holes; nuts and washers are set tight; and the bail is replaced in the eye-bolt. If care has been taken that the leather is reasonably pliable and the flap iron has a slight roll so that the leather makes general contact with the pipe, this valve will function properly for several years. It can be renewed by replacing the leather any time the line is empty.



Mine Cars

Bottom-Dump and End-Dump Types

(PART FOUR)

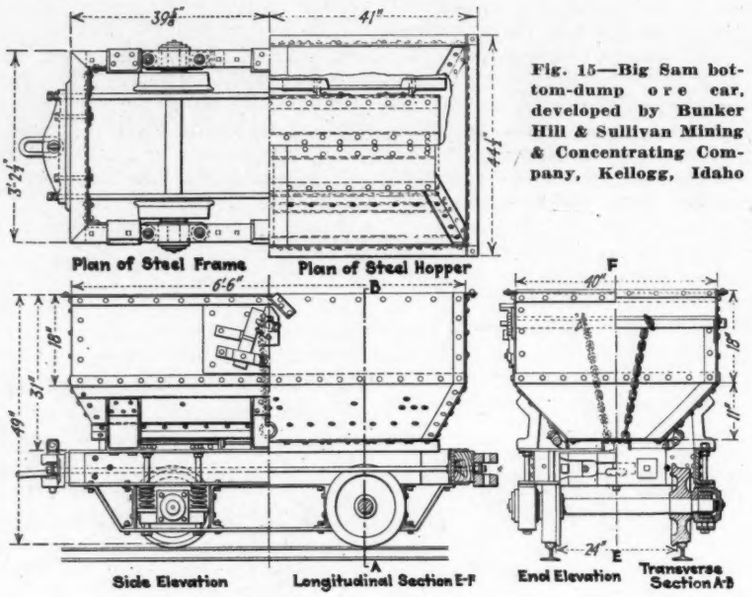


Fig. 15—Big Sam bottom-dump ore car, developed by Bunker Hill & Sullivan Mining & Concentrating Company, Kellogg, Idaho

A. H. Hubbell

Associate Editor

BOTTOM-DUMP cars, used extensively in railroad work, are not commonly met underground. The types described in the following are used by two companies, respectively, in the Coeur d'Alene district of northern Idaho. Obviously, a car of this general type is applicable in underground service only where the maximum size of ore fragment is comparatively small.

The cars referred to are the so-called Big Sam (Fig. 15) car, used by Bunker Hill & Sullivan Mining & Concentrating Company, Kellogg, Idaho, and the 82-cu.ft. car of the Hecla Mining Company, at Burke, shown in Fig. 16. They were designed by their respective users. In both mining operations the ore is galena in quartzite and may be wet at times but is seldom sticky. It runs 15 to 16 cu.ft. to the ton, broken. The maximum size and weight of fragments of Bunker Hill ore are approximately 10x10x12 in. and 110 lb. respectively, the average piece being about 2x2x4 in. and weighing 1 lb. Hecla's ore is said to break in pieces ranging from fines to a maximum size of 10x12x18 in. In each case, the car is loaded from chutes.

According to Stanly A. Easton, vice-president and general manager of the Bunker Hill & Sullivan company, the cars originally used in the company's 10,000-ft. adit, about 28 years ago, were of the gable-bottom type, and were too small and too frail for the work. These shortcomings led to the design of the Big Sam car, which is used today, not only in the Kellogg tunnel level, in the dimensions hereafter given, but also in a smaller size on the lower levels of the mine, where storage-battery haulage is used. The original design has been improved in details but not substantially changed. Mr. Easton says that in planning the car he was inspired somewhat by a similar car used at the Homestake mine, Lead, S. D., but for surface work only.

The car, as used throughout the workings, save on intermediate and lower levels, has a capacity of approximately 40 cu.ft., corresponding to about 4 tons of high-grade lead ore. Empty, it weighs 2,900 lb.; loaded, on the average, 10,100 lb. It is hauled in trains of 18 an average distance of 10,000 ft. by 4-ton trolley locomotives. The tunnel is 8x8 ft. in cross-section, the minimum radius of curve being 25 ft. Grade of track is 0.33 per cent maximum, and 0.25 on the average. Gage is 24 in. throughout. The tonnage to be moved on the level is 1,400 daily and the average time allowed for a round trip is one hour. The train is operated by one man only, extra men being required for loading and dumping. On intermediate and lower levels, a car of about 25 cu.ft. capacity is used.

Cost of car maintenance per ton hauled and trammed is estimated at 0.5 cent. Anti-friction roller bearings and spiral springs are used; also solid steel frames in part, though because of elasticity wooden frames are preferred.

The dumping mechanism is simple. Two longitudinal doors on the bottom of the car are held closed by chains which wind on a transverse shaft secured by a pawl and ratchet. Dumping is done by knocking out the pawl and is said to take no longer than the dumping of Granby cars or of rigid-box cars with a tipple.

The Hecla company's car, as used for main haulage in the Hecla mine, is of 82 cu.ft. capacity. A car of approximately the same design but of 140 cu.ft. capacity is used for main haulage in the Star, which is connected with the Hecla shaft by a 2-mile crosscut. Both cars were developed by the company, according to James F. McCarthy, general manager, who adds that, if he were to re-equip the Hecla mine, he would use the 140-cu.ft. car for main haulage.

Loaded, the 82-cu.ft. car weighs 14,040 lb; empty 4,040. It is hauled in trains of five to eight cars a distance of 2,000 to 4,500 ft., over grades of 2 per cent maximum and 0.75 on the average, by 3½- to 6-ton. storage-battery locomotives. The haulageways are 5x7 ft., 8x8 ft., and larger, and the minimum radius of curve is 28 ft. Track gage is 24 in. A train crew of two men suffices also for loading and dumping. The tonnage to be moved varies on each level. Dumping is done by releasing a ratchet. Details of construction are shown in Fig. 16.

Plain bearings are used. The cost of maintaining this particular car has not been segregated by the company.

OF all cars used in underground transport of ore, the so-called end-dump type is the most familiar, Many companies, having a moderate tonnage to handle and no particular haulage problem, move their ore and rock with it from stope or face to shaft or chute, to the extent a car is needed for this purpose. In construction, it is simple, as the illustrations show, the body being mounted and balanced so as to be easily tipped, thereby discharging its contents through a hinged end door, which is

Part I of this article dealt with the Granby-type car; Part II with the gable-bottom and rocker-dump types; Part III with the rigid-body box type. Part IV deals with bottom-dump types of special design and with the end-dump type. The series is concluded with this installment.

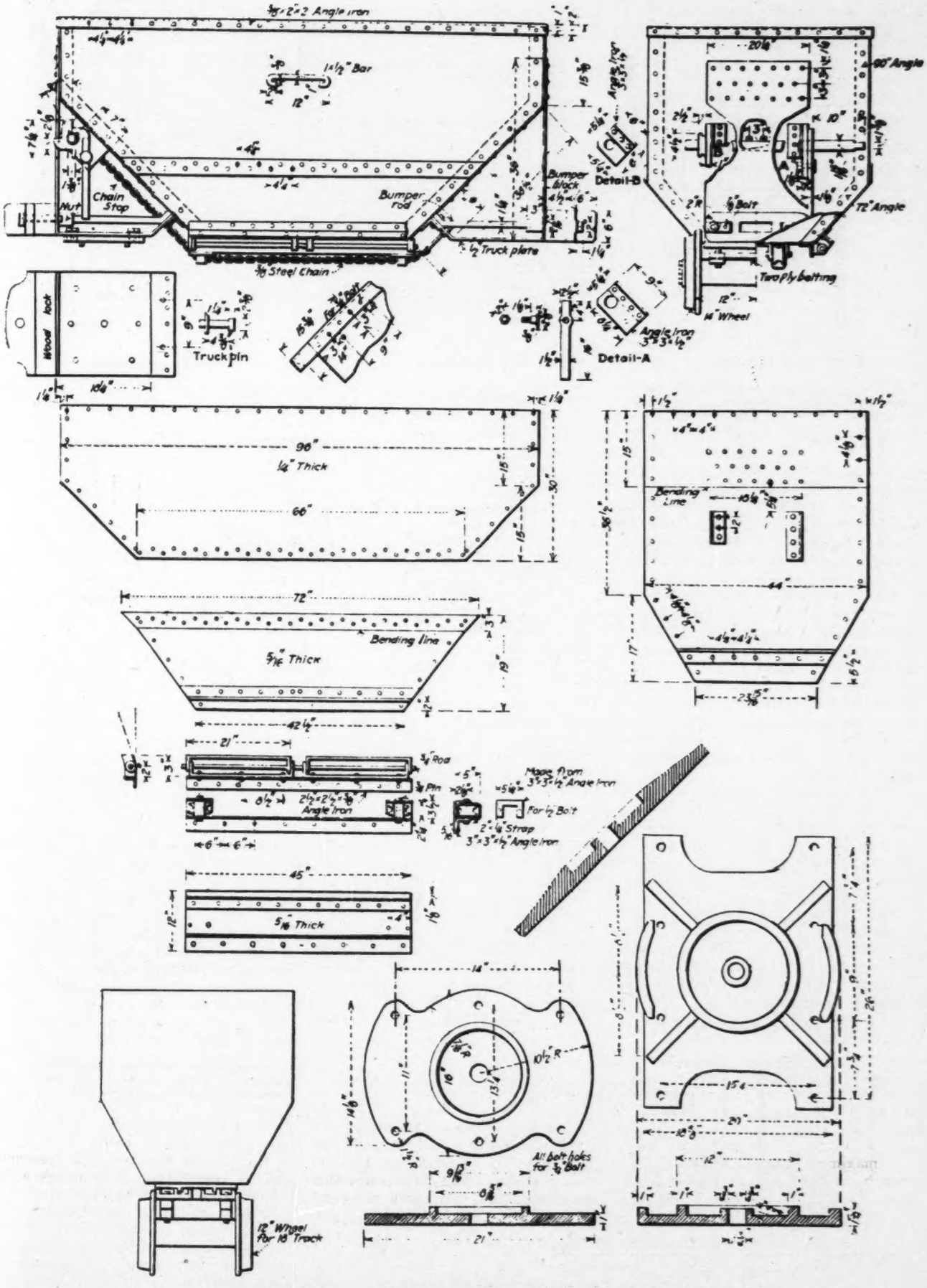


Fig. 16—Details of Hecla Mining Company's bottom-dump ore car

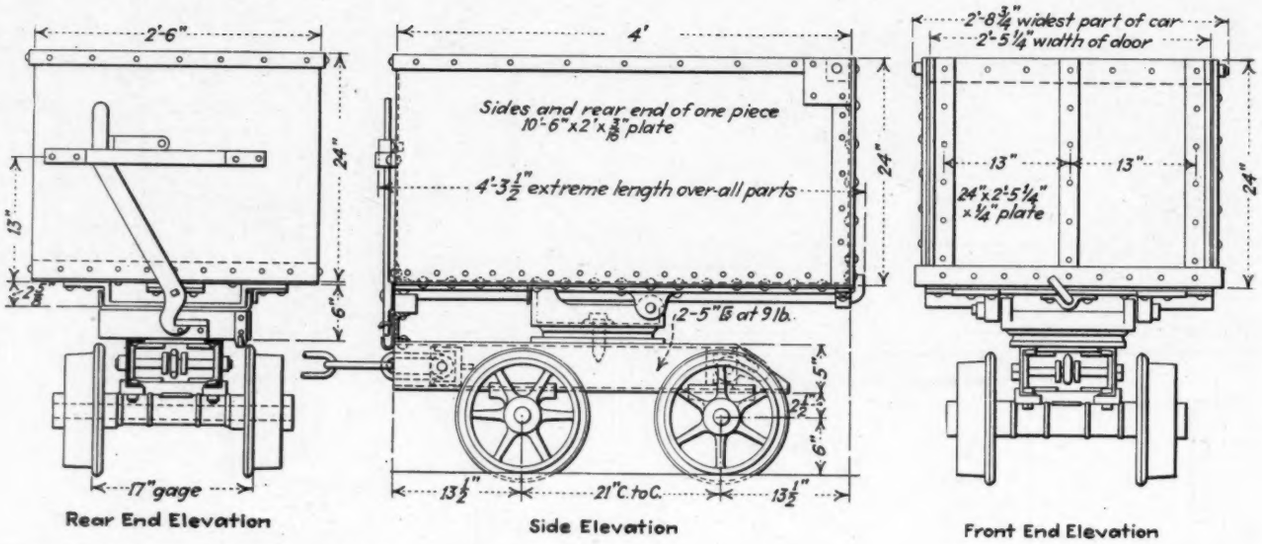


Fig. 17—End-dump car used by Park City Consolidated Mines Company, Park City, Utah

first released by means of a lever and catch. Sometimes the body is mounted so as to be rotatable through 90 deg. to permit dumping to one side. Usually the end-dump car has a capacity of 1 to 1½ tons, though sometimes larger, and on this account can readily be trammed by hand or hauled in trains as conditions may require. Its customarily modest dimensions permit it to be moved readily from level to level by cage or other means. This flexibility and adaptability to widely varying conditions account in large measure for its popularity, although its use by some companies no doubt spells inefficiency of transport. Also, the cost of maintaining it is high.

Many companies requiring a larger, more sturdy car for main haulage work use the end-dump type for intermediate haulage on other levels. It is by far the one most used for intermediate work. In the following four different cars are discussed.

Fig. 17 shows an end-dump car used by the Park-Utah Consolidated Mines Company, Park City, Utah, for intermediate haulage. (The gable-bottom car and the rigid-body car used by this company were discussed in Parts II and III respectively.) The ore handled is galena, much of it wet and sticky, and runs 17 cu.ft. per ton, broken. Pieces average 3 in. in size, the largest being 15 in. The car is loaded by hand-shoveling and from chutes and is dumped by hand. Loaded, it weighs 3,200 lb.; empty, 1,100. It is trammed

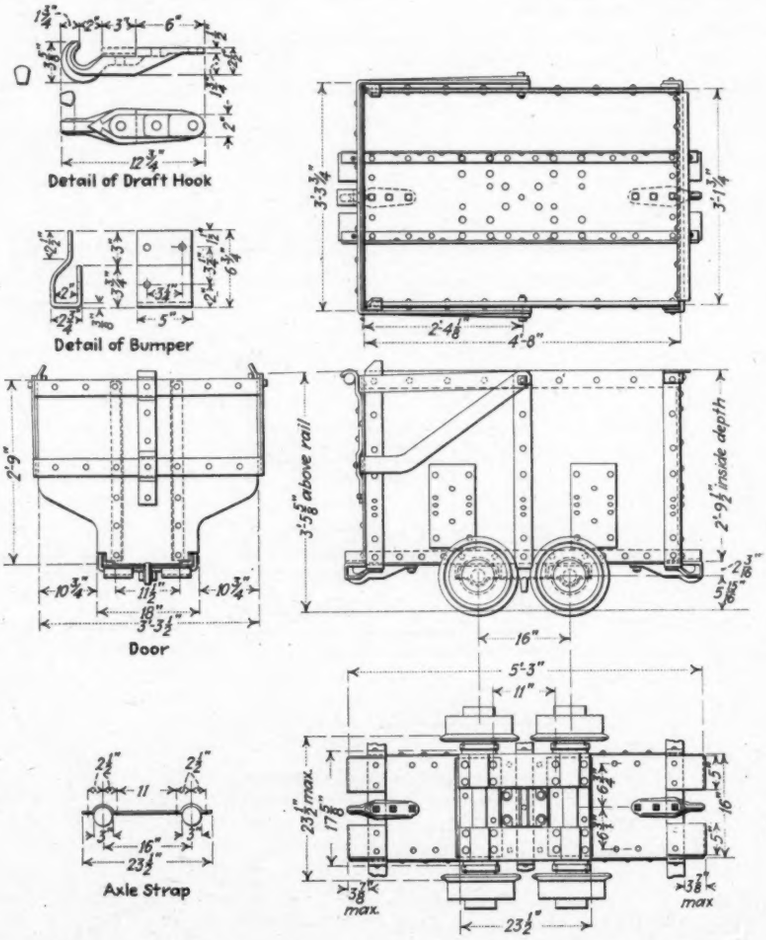


Fig. 19—Vinegar Hill Zinc Company's standard 1½-ton end-dump car for self-dumping cage, Platteville, Wis.

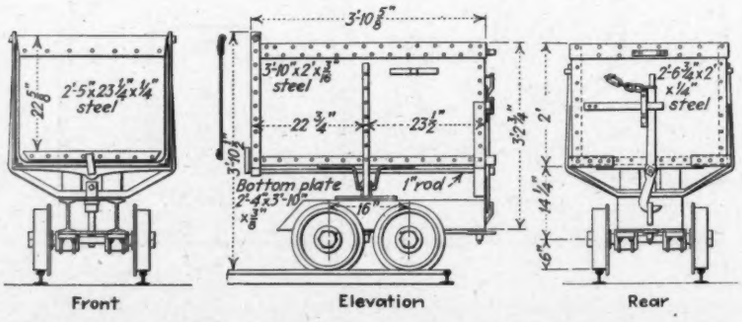


Fig. 18—One-ton end-dump car used by Homestake Mining Company, Lead, S. D.

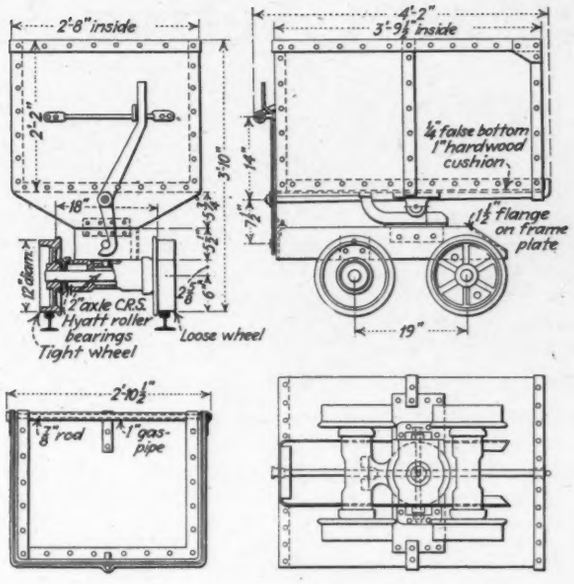


Fig. 20—End-dump car, 22 cu.ft. capacity, used by Hillside Fluor Spar Mines, Rosiclare, Ill.

either by hand, the distance not exceeding 1,000 ft., or it may be hauled in trains of 10 by horse, or in trains of 30 by 4-ton trolley locomotives, the distance in this case averaging 2½-miles. Track grade averages 0.5 per cent, the maximum being 1.5. Curves are sharp. Roller bearings are used. Drifts are 5x6 ft. in cross-section. Tonnage to be moved on the different levels varies from 100 to 500 daily. A round trip on a 1.5-mile motor haul takes 1¼ hours. Two men constitute the train crew, this sufficing for all work. Seven hundred man-hours are charged monthy to maintenance, the cost per ton hauled and trammed being estimated at 10c.

A 1-ton end-dump car used by the Homestake Mining Company, Lead, S. D. is shown in Fig. 18. It is used under the same conditions as the company's 1-ton gable-bottom car described in Part II. Loaded, it weighs 3,200 lb.; empty, 1,200. Brass bearings are used. The maintenance cost is not available.

An end-dump car of somewhat different design is shown in Fig. 19. It is used by the Vinegar Hill Zinc Company, Platteville, Wis., to haul wet and sticky zinc-lead ore, running 13 cu.ft. per ton, broken, and breaking in pieces ranging from fines to 24 in. in size, the largest weighing 150 lb. It is loaded by hand-shoveling; also from chutes and mechanically. The weight, loaded, is 4,800 lb.; empty, 1,800.

This car is hauled in trains of ten by 3½-ton gasoline locomotives a distance averaging 1,000 ft. The grade is 3½ per cent maximum and 0.5 average. Minimun radius of curve is 8 ft. The car is also trammed by hand an average distance of 200 ft. Drifts are 6x9 ft. in size. The tonnage to be moved on each level is 500. The train crew consists of one man, additional help being required for loading but not for dumping, which is done automatically. Twenty-four man-hours are charged monthly to car maintenance, the cost of such maintenance being estimated at 0.005c. per ton hauled and trammed.

Fig. 20 shows a 22-cu.ft. car used by Hillside Fluor Spar Mines, Rosiclare, Ill. The ore is calcite, limestone, and fluorspar, some of it wet. It runs 18 cu.ft. per ton, broken, the largest pieces being about 24x18x12 in. and weighing 1,000 lb. The fragments average 6 in. in size and 20 lb. in weight. Loading is done by hand-shoveling and from chutes. Loaded, the car weighs 3,500 lb.; empty, 800. To dump, a rotary end dump is used, a cradle serving to prevent upsetting.

Hand-tramming is employed, the distance averaging 500 ft. Track grade is 0.5 per cent on the average and 1 per cent maximum. Bearings are Hyatt rollers. Drifts are 7x8 ft. in cross-section, and the minimum radius of curve is 12 ft. About 150 tons must be moved in eight hours on each level. Eight man-hours are charged monthly to car maintenance.

An end-dump car of rather different appearance from those described is shown in Fig. 21. It is the 18-cu.ft. scoop-body car used by United Verde Copper Company, Jerome, Ariz., for tramming waste in cut-and-fill stopes and in square-set stopes. The waste runs about 22 cu.ft. per ton, broken, the pieces being about 5 lb. in weight on an average and 75 lb. (11 in.) at most.

The car is loaded from chutes, trammed an average distance of 75 ft., and dumped by hand. Loaded, it weighs 2,400 lb.; empty, 650. With it, about 60 cars of waste per stope are handled in eight hours. It has roller bearings. About 400 man-hours are charged monthly to maintenance, the cost of which is said to be 5c. per ton of waste handled.

United Verde also uses an 18-cu.ft. end-dump car of the ordinary type in stopes, and for level haulage the 30 cu.ft. rocker- (or trunnion-) dump car, described in Part II.

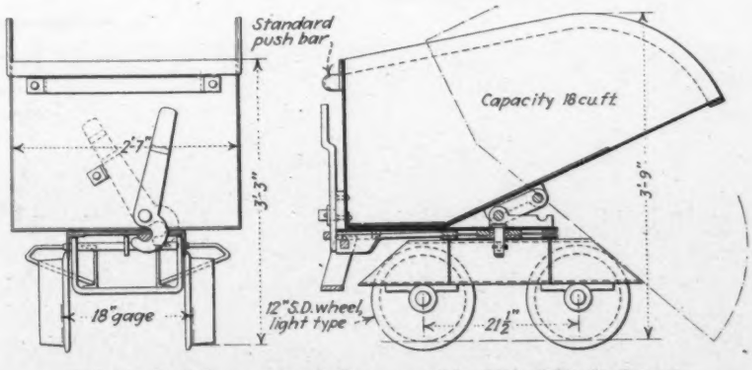


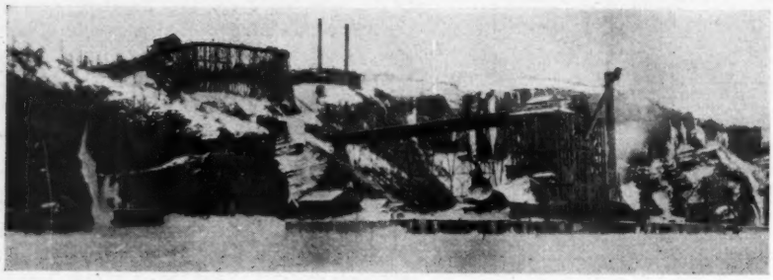
Fig. 21—End-dump scoop-body car used by United Verde Copper Company, Jerome, Ariz.

Splicing Tracing Cloth

SPLICING and patching of tracings can be readily accomplished by the use of collodion or similar cement of cellulose base, using ether or acetone as a solvent. Any one of several trade preparations is satisfactory, but flexible collodion containing castor oil does not seem to produce good results. Butt joints are superior to lap joints for this work, both in strength and appearance. There is no difficulty in ruling or lettering across a well-made butt joint and only a slight streak is evident on blueprints. The tensile strength is equal to the original strength of the cloth, and a well-made joint is reasonably permanent with ordinary use.

A closely matched joint may be secured by first lapping the edges and then cutting through both thicknesses with a sharp blade held against a straight-edge. If the portions of the tracing to be spliced tend to curl, the edges should be brought together with the convex side upward. A small groove will thus be formed along the seam. A medicine dropper will be found useful in applying the collodion or cement. After drying, a light coat of cement should be placed on the reverse side. There is no advantage in making the width of the cement application more than one-eighth of an inch.

Newfoundland's Active Mines



Loading pier and trestle of Dominion Iron & Steel Company, taken from the frozen bay

The Future Outlook

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OF THE two mining properties that are operating in Newfoundland today the more important is the Wabana iron mines. These mines are situated on Bell Island, in Conception Bay, a short distance north of St. John's. Bell Island is reached by boat from Portugal Cove, a distance of a few miles. The ore occurs in beds, interbedded in a series of sandstone and slate sediments. It is a reddish brown hematite of fine-grained oölitic structure. There are three beds of the general characteristics given in Table I.

Table I—Dimensions of Wabana Beds

Name	Thickness, Feet	Length, Outcrop, Miles	Dip Length, Miles
Upper	....	70 acres	
Scotia	8	2	2
Dominion	8–26	3.5	2.5

The ore is won from several mines. General analyses are given in Table II.

Table II—Analyses of Wabana Ore

Mine No.	Bed	Fe	SiO_2	Analysis P	Capacity (1927) Tons per Twenty-four Hour
2	Dominion	52.43	12.94	....	1,500
3	Dominion	52.0	12.0	....	1,200
4	Dominion	52.9	11.6	....	750
6	Scotia	52.5	8.93	....	1,500
	Average	51.72	11.58	0.92	Total 4,950

Ore reserves are given in Vol. 1 of the International Geological Congress ("World Iron Ore Resources") as 3,635,000,000 tons based upon geological evidence. This tonnage entitles the deposit to rank among the foremost of the world's reserves of iron ore.

The ore beds dip at a flat angle northward, outcropping on the north shore of Bell Island within a few hundred yards of the coastline. Some of the workings are over a mile from shore. The mining method is simple. A half cut is taken under the roof and from it the remainder of the ore is benched down. Electric shovels load the ore into cars that are hauled to pockets on the inclined gangway. The ore is then transferred to cars operating on the gangway. These cars dump into surface pockets. The ore is transported about 2 miles to the south side of Bell Island by cable tramways. These discharge into large open pockets from which the ore steamers are loaded. The recovery in the submarine area is 55 to 60 per cent initially, with a small additional increment won from pillar trimming after sections have been completed.

Shipments and invoiced values from 1918 to 1928 are given in Table III.

Table III—Wabana Ore Shipments

Year	Tons	Value per Ton
1920–21	514,203	$1.20
1921–22	484,322	1.33
1922–23	1,004,138	1.70
1923–24	744,075	1.73
1924–25	1,117,429	1.70
1925–26	1,063,973	1.70
1926–27	929,159	1.70
1927–28	1,542,292	1.70
1928–29	1,516,997	1.70
1929–30	1,117,961	1.70

For the last three calendar years the distribution of this production has been as given in Table IV.

Table IV—Exports of Wabana Ore

To	1928, Tons	1929, Tons	1930 Tons
Germany	894,493	724,645	661,406
Sydney, Nova Scotia	616,354	700,000	467,784
United States	37,048	76,340	48,771
Scotland	.....	5,330	.....
Totals	1,547,895	1,506,315	1,177,961

Production at present is at an increased rate and should exceed 2,000,000 tons annually. That the immense reserve, at tidewater, and the established diversified market will result in continued production, probably at an increasing rate, is therefore apparent. Completion of the St. Lawrence waterways to the Great Lakes will bring up the question of the economics of the

Concentrator and settlement

delivery of Wabana ore to the lower Lake furnaces in the United States. Bell Island is and probably will continue to be the backbone of mining in Newfoundland.

The second mining operation of interest is that at the Buchans mine. This property is owned jointly by the Anglo-Newfoundland Development Company and the American Smelting & Refining Company, and is operated by the latter. It is in the interior of the island south of Millertown Junction, with which it is connected by a branch line. The property was discovered early in the twentieth century by Matthew Mitchell, a prospector in the employ of the Anglo-Newfoundland Development Company, but exploitation was impossible until selective flotation was sufficiently developed to permit proper segregation and concentration of the ore into proper concentrates. At the same time geophysical prospecting was instrumental in finding indications of additional orebodies, resulting in an adequate tonnage sufficient to justify the high initial capital expense necessary to put the property into operation on a substantial scale. This operation is an illustration of the results of flotation and geophysical prospecting.

The geology of the Buchans area has been adequately described by Hans Lundberg.[1] The country rocks are bedded tuffs and lava flows, with occasional thin beds of greenstone. Contacts with the porphyrite are not generally well defined. These contacts and adjacent parts of the conglomerate are mineralized. The ore itself is an intimate mixture of the sulphides of copper, lead, and zinc in a barite gangue. This ore is found in several non-contiguous bodies. Reserves, as of Jan. 1, 1930 (latest available), were 7,150,000 tons of the following analysis: Au, 0.04 oz. per ton; Ag, 3.64; Cu, 1.13 per cent; Pb, 7.28; Zn. 16.27 per cent.

Operations are at the rate of 500 to 600 tons daily, with construction[2] in progress to increase this to 1,000 to 1,200 tons daily. From figures published covering the first year's operations[3] and data filed in Newfoundland with the government the deductions in Table V are possible.

Table V—Cost and Other Data, Buchans Mine

Tons mined, ore	166,536
Tons concentrates (lead and zinc)	73,508
Ratio concentration, total	2.27 to 1
Ratio concentration, zinc	3.28 to 1
Ratio concentration, lead	7.82 to 1

Costs	Per Ton Ore	Per Ton Concentrates
Mining, milling	$6.60	$15.00
Haulage, ocean freight	2.64	6.00
Smelting	9.70	22.00
Total	$18.94	$43.00
Profit	6.59	15.00
Gross recoverable	$25.53	$58.00

Upon the assumption of average-grade ore having been mined, and of average values for the metals for 1929, an over-all recovery of 80 per cent is indicated. On the basis of 500 tons daily, the annual metal production would be (in round numbers):

Gold, oz.	5,600
Silver, oz.	500,000
Copper, lb.	3,000,000
Lead, lb.	20,000,000
Zinc, lb.	22,000,000

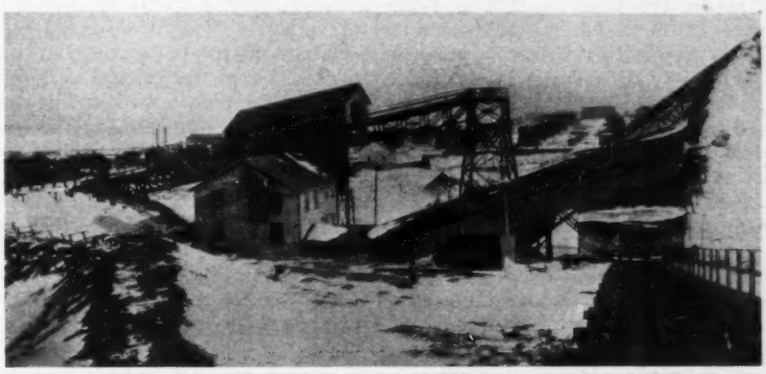
Both smelting and refining of this output are now done in Europe. The copper probably goes with the zinc concentrate and the silver largely with the lead. Ore reserves are sufficient for twenty years' operation at the 1,000-ton rate, indicating a future annual output of about double the foregoing figures. The present mineral output of the island is therefore annually (from the two founded operations):

Iron ore, tons	1,500,000
Gold, oz.	5,000 to 6,000
Silver, oz.	500,000
Copper, lb.	3,000,000
Lead, lb.	20,000,000
Zinc, lb.	22,000,000

Considering the future outlook for mining in Newfoundland, continuance of the two operations mentioned is assured. Bell Island's output will be limited only by the volume of its market. Buchans could reasonably be expected to increase to 1,500 tons daily should the prices for lead and zinc warrant.

Plans are under way for re-equipment and operation of Tilt Cove when copper prices return to normal. Plans are also on foot for the equipment and operation of Gull Pond. The reserves at Tilt Cove are estimated as follows:

	Tons
Positive ore	1,825,000
Probable	2,160,000
Possible	4,680,000



"Deckhead" of No. 3 Submarine mine, Nova Scotia Steel & Coal Company, Ltd., Wabana, Newfoundland

The grade is estimated at 2.5 per cent copper. Production costs, including depreciation and depletion, are estimated as follows:

	Cents per Pound
On a scale of 500 tons per day	9.45
On a scale of 1,000 tons per day	8.85
On a scale of 2,500 tons per day	7.40

Gull Pond has more than 2,000,000 tons of proved ore of a slightly higher grade, but the less favorable conditions indicate a production cost of 10 to 11c. per pound for its copper.

Both the Betts Cove and Little Bay properties would probably resume production were the Tilt Cove mine to be put into efficient operation.

[1] Technical Publication 98, A.I.M.E., p. 32-36.

[2] Constructing transmission line for power from Deer Lake power house of I. P. & P. Co.

[3] *Engineering and Mining Journal*, March 8, 1930.

at Buchans mine, Newfoundland

Pyrite production from Pilleys Island and as a byproduct from Tilt Cove and Betts Cove is not unlikely. A normal adequate market is available for its output with the numerous tidewater paper plants that are found along the St. Lawrence.

A number of interesting explorations and developments, in strong hands, are under way in the area between Notre Dame Bay and Buchans. The resulting finds have been widespread and significant, and it is expected that ultimately one or more of them will yield a commercial orebody of some of the base metals.

Manifestly, also, a smelter will ultimately be erected on the island when the output of concentrate becomes large enough and its reliability is assured. Newfoundland is thus destined to become ultimately an important factor in the base-metal production of the Atlantic seaboard. Continued skilled and aggressive development is needed to accomplish this and capitalize its strategic position geographically and the natural advantages it enjoys from the standpoint of power, labor, and water transportation.

Acknowledgment is herewith made for data and photographs secured from the following: Hans Lundberg, of the Swedish American Prospecting Company; H. A. Guess, of the American Smelting & Refining Company; Messrs. Hatch and Palmer, of St. John's, Newfoundland, and D. James Davies, government analyst of Newfoundland.

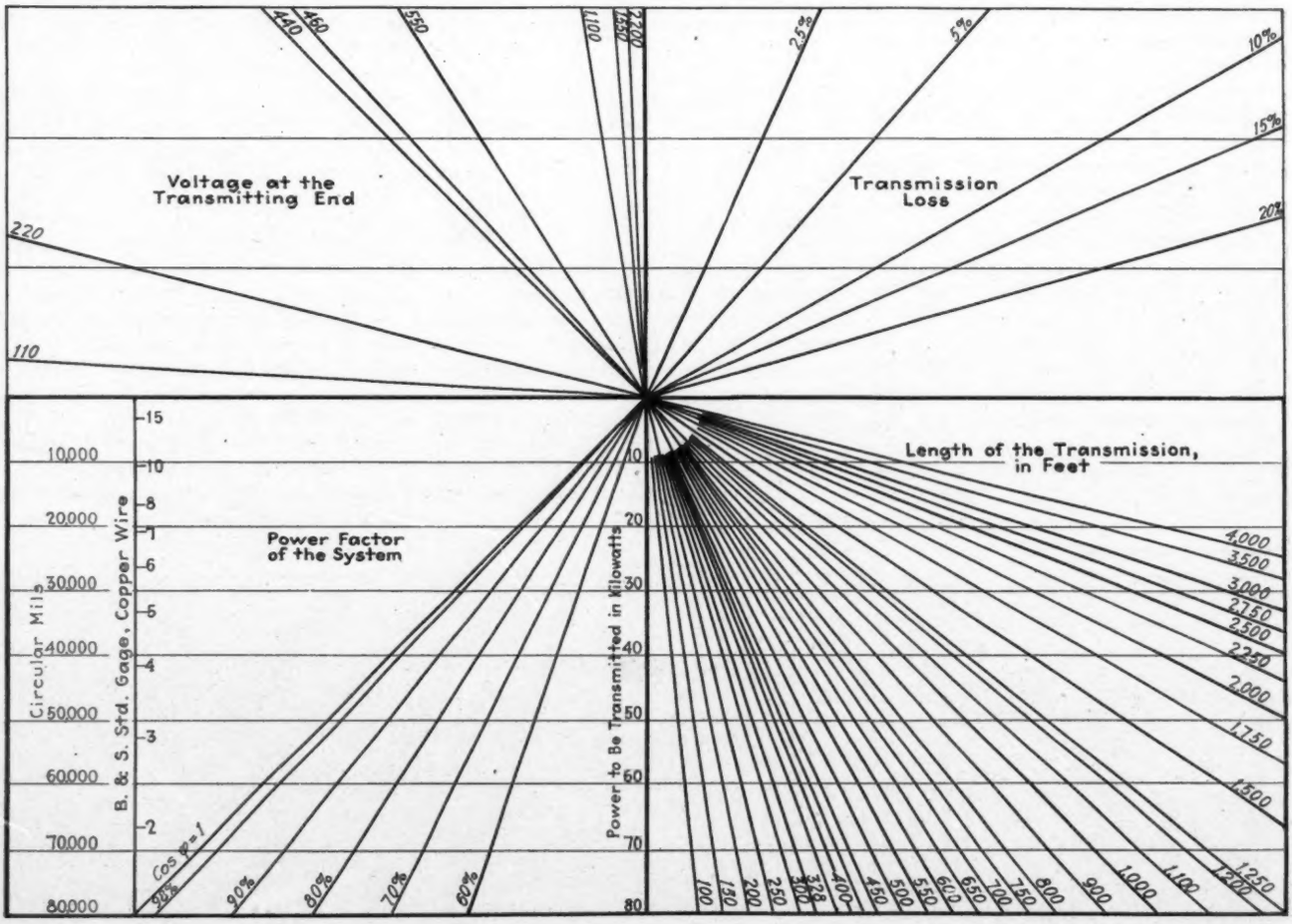
■ ■ ■

Electrical Transmission Chart

A CHART, shown herewith, for determining the approximate size of conductor for short electric power lines such as are commonly used within the premises of mines, mills, and smelters has been prepared by Gilberto Luna, of Cia Minera y Beneficiadora de Indé, Indé, Durango, Mexico. It may be applied to three-phase, three-wire transmissions and is based on the following formula: *Circular mils = 2,160 x length of line in feet x power in watts ÷ 2 x (power factor)² x (voltage)² x percentage of loss.* As the effect of reactance has not been taken into consideration, the formula is limited to cases where this factor may be disregarded. For all practical purposes, however, the results will be close enough for transmissions up to a length of 20 miles and for voltages up to 23,000 volts.

Directions for using the chart are as follows: From the vertical scale giving power to be transmitted in kilowatts, a horizontal line is drawn to the line on the right indicating the length of the transmission; from the intersection the line is continued vertically to the "Transmission-Loss" line, then horizontally to the "Voltage" line, and finally vertically down to the "Power-Factor" line. A horizontal line drawn from the last point of intersection will give the gage number of the copper wire or the area of its cross-section, in circular mils.

For quantities not included in the chart, interpolations are made according to the formula. For 11,000 volts, for instance, determine the value for 1,100 volts and divide the result by $11{,}000^2 \div 1{,}100^2$, or 100; for 230 volts, determine the value for 460 volts and multiply the result by 4. If the distance is 35,000 ft., use 3,500 ft. and multiply by 10. For 500 kw., use 50 kw. and multiply by 10. In case of single-phase two-wire transmissions, multiply the result by 2; for two-phase four-wire transmissions take the result as given by the chart. For direct-current transmissions, determine the value for unity power factor and multiply the result by 2.



Effect of Grinding Time and Pulp Dilution on Flotation

A. W. Fahrenwald and L. T. Abele

Respectively Professor of Metallurgy and Ore Dressing, School of Mines, University of Idaho, and Research Fellow in Ore Dressing, Idaho Bureau of Mines and Geology

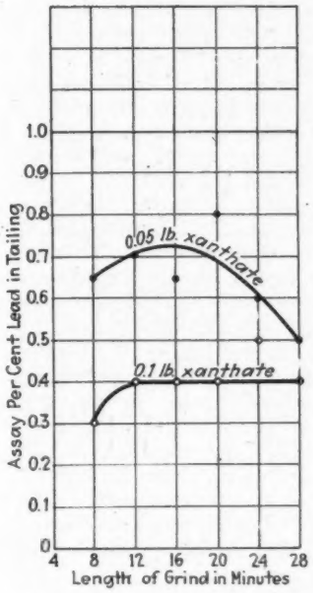


Fig. 1—Lead losses, using 0.05 and 0.1 lb. xanthate per ton

IF A SAMPLE of flotation tailing be sized with a fine-mesh sieve (say, 0.0017 mm. opening), the material passing through almost invariably has a higher assay value than that remaining on the sieve. Also, a fine (deslimed) sand is better adapted to flotation in every way than the unclassified pulp: recovery is higher, the grade of concentrate is better, the reagent consumption is less, and so is the time required for separation. The presence of any valuable mineral at all in the coarser tailing remaining on the sieve can be accounted for either because of the presence of unlocked middling grains or of clean mineral pieces too coarse to float. The relatively higher assay value of the part of the sample passing the sieve is not so easy to explain satisfactorily. A number of reasons, however, are suggested:

1. Slimed mineral and slimed gangue flocculate among themselves or with each other, inhibiting the particles from participating in the chemical reactions necessary for flotation.

2. Extremely fine grains are, for the same reason, inherently less floatable than coarser ones.

3. The slime portion is of so-called primary origin (occurring naturally in the ore and not resulting from overgrinding) and therefore is of true colloidal character. Consequently it possesses physical and chemical properties different from the sand grains.

4. Over-grinding of the mineral (caused by improperly operated mills, or improper circulating load or pulp dilution, or poor classification).

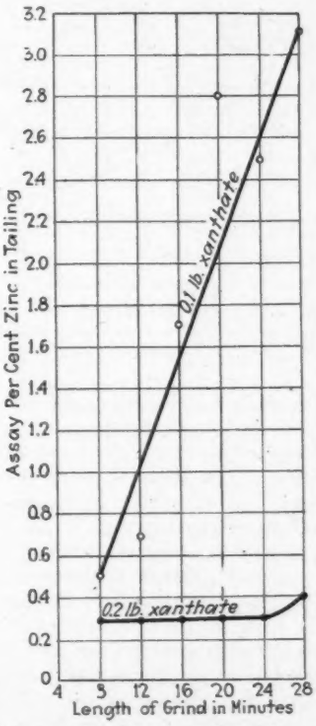


Fig. 2—Zinc losses, using 0.1 and 0.2 lb. xanthate

Electrical charges should perhaps be considered, for physical chemistry teaches that solid-liquid interfaces are electrically charged and that suspended fine particles in water are charged strongly or weakly, positively or negatively, depending upon their chemical constitution and the purity of the water.

Taggart, Taylor, and Ince have studied the effect of ore slime upon the flotation of various pure minerals, their work indicating clearly that slime coating of minerals takes place in flotation pulps and that this is an important factor in differential flotation. Ince concluded from the results of his work that (1) slime does or does not coat sulphide particles according to the electrical charges existing on the surfaces of the two types of particles; (2) the nature and magnitude of the electrical charge may be altered by dispersion agents; (3) the amount of slime coating can be controlled by means of dispersion agents; and (4) a slime-coated sulphide does not float so readily as one that is slime-free. These are significant conclusions, but they do not have much bearing upon why slime grains themselves float poorly. The work, however, suggests that mineral-slime loss is the result of deposition on relatively coarse gangue sand—that is, slimed galena or slimed sphalerite coat quartz, siderite, or other non-floatable sand grains and ride on these to their escape.

The purpose of the work outlined in this article was primarily to study the effect of fineness (time) of grinding and pulp dilution in the ball mill (not in the flotation machine) on flotation, concentrate grade, and tailing losses.

For these experiments the ore selected was a complex lead-zinc ore from the Morning mine of the Federal

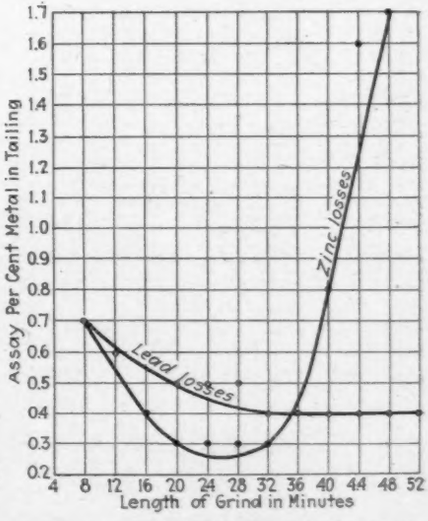


Fig. 3—Lead and zinc losses plotted against time of grind. Pulp dilution constant at 2:1

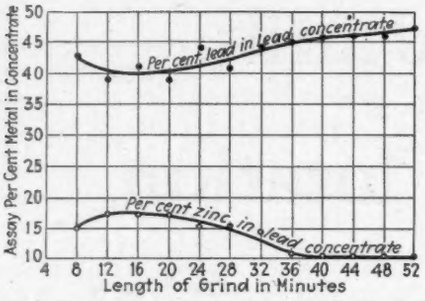

Assay Per Cent Metal in Concentrate
Per cent lead in lead concentrate
Per cent zinc in lead concentrate
Length of Grind in Minutes

Fig. 4—Lead and zinc in lead concentrate compared with time of grind. Pulp dilution constant at 2:1.

Mining & Smelting Company, Mullan, Idaho. The minerals to be floated were galena and sphalerite. Those to be rejected as tailing were siderite, quartz, quartzite, and a small percentage of pyrite and rhodocrosite.

The sample was received largely in chunks and reduced, for experimentation, by crushing in a jaw crusher and rolls. Both the plus-10-mesh and minus-35-mesh portions were screened out, the minus-10 plus-35 sand being saved for the experiments to follow. This product assayed 11.0 per cent lead and 7.00 per cent zinc. It is assumed that this feed contained practically no primary fines and slime.

The mill used for grinding was 4.8 in. long by 10 in. in diameter. It was rotated at a constant speed of 65 r.p.m. The ball charge was 20 kg. of 1-in. steel balls. The feed charge was constant throughout the experiments at 1 kg. These conditions approximate those common in laboratory practice. All flotation tests were made in a self-aërating, gravity-flow, mechanical-type machine. Assumption has been made that machines of other types would have given similar results—that is, the type of machine is not considered an important element affecting the results of this study. Sizing was done

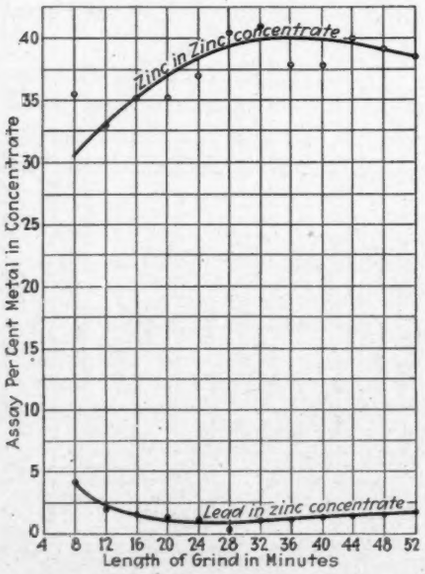


Fig. 5—Zinc and lead in zinc concentrate compared with time of grind. Pulp dilution constant at 2:1.

with Tyler sieves to minus-325 mesh, further sizing being effected by elutriation. In the grinding and flotation part of the work a standardized technique similar to common laboratory routine testing was employed. Concentrate cleaning was omitted.

In this article the tabulated data resulting from the numerous experiments conducted are omitted, as the results are depicted graphically.

The reagents used in all tests were as follows: For galena flotation: soda ash, 3.0 lb. per ton; sodium cyanide, 0.2 lb. per ton; sodium ethyl xanthate and No. 5 steam distilled pine oil as required. For sphalerite flotation: copper sulphate, 3.0 lb. per ton; sodium ethyl xanthate and No. 5 steam distilled pine oil as required. The quantities of

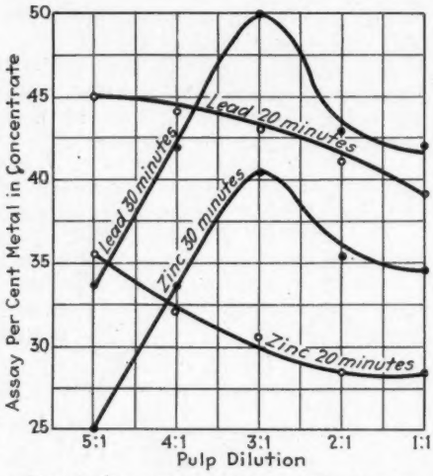


Fig. 6—Percentage of lead and zinc in concentrates for the 20- and 30-minute grinds

all reagents, other than the xanthate, were assigned on the basis of practice at the plant from which the sample was obtained. Reagent requirements, particularly depressants, activators, and collectors, are assumed to be determined to a large extent by the fineness of the feed—that is, the total surface of the sand. This was taken into account only in the case of the collector.

Data from two sets of experiments varying time of grind and amount of collector are plotted in Figs. 1 and 2. The trends of these curves indicate that 0.10 lb. of xanthate per ton for lead and 0.20 lb. xanthate per ton for zinc are required for satisfactory recovery of those metals respectively, for grinds up to 28 minutes. That is, when these quantities of xanthate are used, tailing losses greater than those indicated are to be attributed probably to other causes. At least, this assumption was made so that a start at the problem in hand could be made.

A number of samples were prepared for flotation tests in which length of grinding varied from eight minutes to 52 minutes in increments of four minutes. The reagents employed were as heretofore specified, 0.10 lb. of xanthate per ton for lead and 0.20 lb. for zinc.

"Lead losses" curve, Fig. 3, is logical. The ore is of the complex class and 32 minutes' grinding under the particular ball-mill condition is required for complete or nearly complete destruction of lead-zinc middling grains. The curves shown in Fig. 4, considered together, are, in their general trends, as might have been expected—that is, the lead concentrate grade increases and the zinc in the lead concentrate decreases with time of grinding. Continued slight increase in the concentrate grade with longer than 32 minutes' grinding, particularly in view of the lead losses' curve flattening out at this point, was, however, not expected. The explanation probably is that galena-siderite or galena-quartz middling grains are not destroyed as soon as is the galena-sphalerite middling, owing to the greater crushing resistance of the gangue minerals. That this probably is the correct explanation is indicated by the flattening out of the "zinc in lead concentrates" curve (Fig. 4) at 32 to 36 minutes.

The "zinc losses" curve, Fig. 3, in part lends itself to an explanation similar to that for the "lead losses" curve of the same figure. The sharp upward trend, after 32 minutes' grinding, probably is caused by (1) insufficient activator and/or collector, or (2) excessive surface production (sliming) in grinding; and (1) is a consequence of (2).

Samples used in the above tests were prepared in a pulp dilution of 2:1. A later similar series of tests in which the pulp dilution was 3:1 (ore to water by weight) does not show the sharp upward bend in the zinc losses' curve. The conclusion is that the non-similarity of the curves results from the variable involved—namely, pulp dilution.

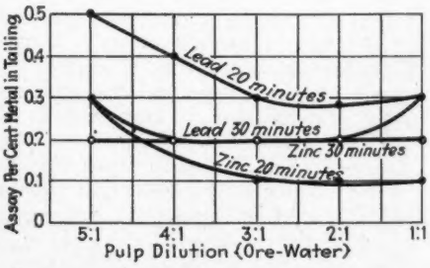


Fig. 7—Losses of lead and zinc in tailing for different pulp dilutions

Curves in Fig. 5 are normal for the first 32 minutes of grinding. The apparent slight falling off of zinc and increase of lead in the zinc concentrate probably is to be attributed to the excessive surface produced and an insufficient amount of activator and collector for sphalerite.

Two groups of samples were prepared for flotation tests. For group one, the time of grinding was constant at 20 minutes; for group two, at 30 minutes. Pulp dilution was the variable. Flotation reagents were as outlined

above. Data resulting from these experiments are presented in Figs. 6 and 7. Careful study of these figures reveals an immense amount of pertinent information, and they are therefore, worthy of discussion.

The 30-minute curves in Fig. 6 pass through an optimum maximum at the 3:1 pulp dilution. Fig. 8 shows that for the mill used, and the conditions of its operation, the most rapid grinding was accomplished in a pulp dilution of 3:1. In view of this, to conclude that the optimum concentrate grade peaks of Fig. 6 are the result of middling destruction through efficient grinding is reasonable.

In Fig. 7 the 30-minute curves have normal trends. Tailing-loss curves are not so sensitive to slight variations in grinding as are concentrate-grade curves, the reason being that middling grains float quite easily.

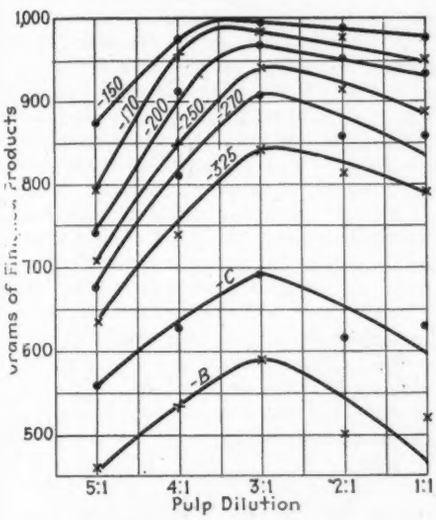


Fig. 8—Weight of finished product for different pulp 30-minute grind

The 20-minute curves, Figs. 6 and 7, are much less easy to account for, particularly in view of the 30-minute grind curves discussed in the foregoing.

If grade of concentrate is dependent upon the amount of middling in the feed, these 20-minute concentrate-grade curves indicate that middling destruction was greatest when grinding in a 5:1 pulp dilution. To explain these curves, it is thus necessary to account for the effect of pulp dilution on grinding during a 20-minute period. For a 30-minute period, the 3:1 pulp dilution unquestionably gives most effective grinding. In other experiments it has been made clear that grinding in a ball mill is affected both by impact and by attrition, conditions in the mill determining which type of grinding predominates. For effective grinding by attrition, grain size and mobility are important factors. In a thick pulp, for a relatively short grind, crushing by impact predominates. For a relatively longer period, grinding by attrition comes strongly into play during the latter minutes of the grind, and is augmented by greater mobility of a 3:1 pulp dilution.

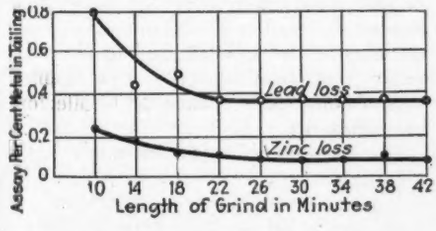


Fig. 9—Lead and zinc losses for constant 3:1 pulp dilution and varying time of grind

This explanation accounts for the 20-minute curves of Fig. 6. The 20-minute curves of Fig. 7 remain to be explained, however. The explanation just offered for the 20-minute curves of Fig. 6, on first consideration seems untenable for the tailing data of Fig. 7, but there is no conflict. It probably is a matter of quantity of activator and/or collector per unit of floatable mineral surface. The more effective the grind, the more surface produced. There probably was a slight reagent deficiency for the 5:1 and 4:1 grinds. In view of data to follow, this explanation, although logical, is open to doubt.

Sizing analysis data of the grinds in which pulp dilution was the variable are plotted in Fig. 8. These data clearly show that the rate of grinding is highest for approximately the 3:1 pulp dilution.

Now, employing a 3:1 pulp dilution in the ball mill, another series of grinding and flotation tests were made, again varying the length of grinding. The concentrate grade and tailing loss data from these tests are depicted in Figs. 9 and 10. The tailing-loss curves steadily fall off with time of grinding for approximately 26 minutes, after which the loss remains practically constant for both lead and zinc. The reader should note that these data do not conform exactly with those of Fig. 3. Minimum lead tailing loss is slightly less. Zinc tailing loss for this pulp dilution (3:1) does not increase after 30 minutes' grinding as it does for the 2:1 pulp dilution. The concentrate-grade curves, Fig. 10, are generally comparable to those of Figs. 4 and 5. Sizing curves for the various grinds with a 3:1 pulp dilution are shown in Fig. 11. *C* and *B* (Figs. 8 and 11) are elutriation products; *C* is the product remaining in the elutriator against a rising current of 1.32 mm. per sec. *B* is the overflow.

A similar set of experiments was conducted on a sample of chalcopyrite-pyrrhotite-pyrite ore to disclose whether or not the results were peculiar to the galena-sphalerite ore. The results were strikingly similar. Also, a series of flotation tests were made in which the time of preagitation in the flotation machine varied from 20 minutes to several hours. The flotation results did not vary over more than the positive experimental error incident to the computation.

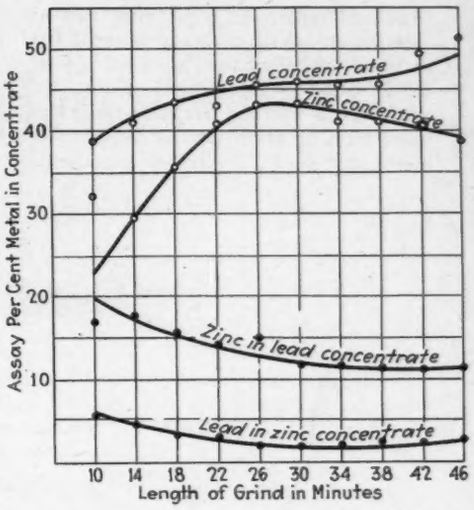


Fig. 10—Percentage of lead and zinc in lead and zinc concentrates

This paper presents graphically the results of laboratory experiments conducted to determine the effect of time of grinding and pulp dilution (in the ball mill) upon flotation metallurgy. A Coeur d'Alene, Idaho, complex lead-zinc ore was used. Primary slime, if any, was present in the original ore, was removed, and all tests were made on ground, clean sand.

Present concentration practice comprises primarily grinding (and classification) and flotation. Usually, the flotation feed is received direct from the ball-mill-classifier unit. The data presented above show fairly conclusively that pulp dilution (ratio ore to water) in the ball mill effects markedly the results obtained from the subsequent flotation of the pulp. The explanation seems to lie in the change in fineness of grinding (total surface)

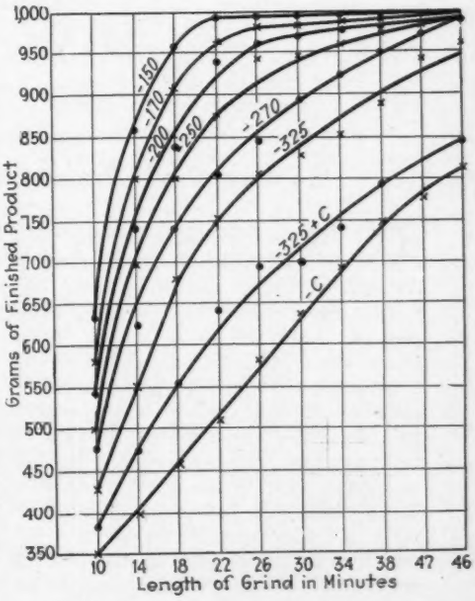


Fig. 11—Relationship of weight of finished product to time of grind

produced under different pulp dilution conditions. With a steady reagent feed to the flotation system, such as is practiced in all well-operated plants, this variation in surface has the same effect upon final flotation results as variation in reagent feed. Therefore to maintain steady conditions in the ball mill-classifier system is as important as to control reagents. Operators have gone to great pains to control reagent feed to a high degree of precision, but have not taken the same care in the control of their grind.

These data show also that a standardized flotation test gives exceedingly valuable information on the grind and that flotation testing should include consideration of grinding conditions as well as the technical application of flotation reagents.

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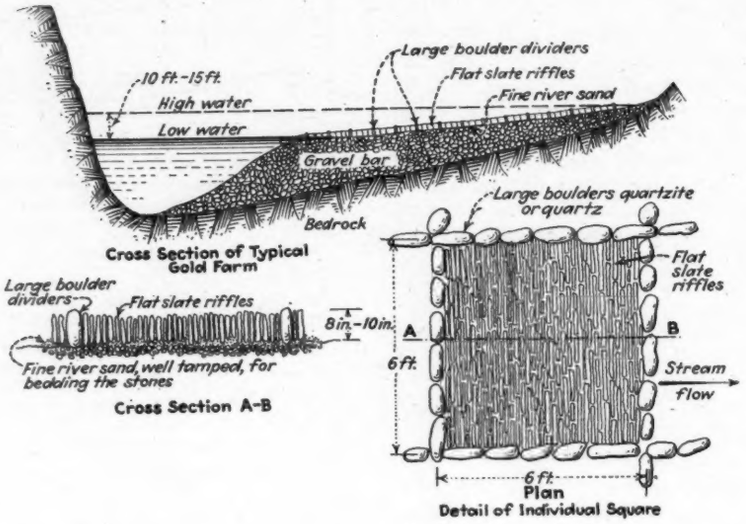
"Gold Farms" of the Inambari



THE *chacras de oro*, or "gold farms," of the Inambari River district in Peru present one of the strangest and most ancient methods of gold recovery, and a description of the procedure is well worth a place in the history of mining, writes Clarence Woods, manager, Inca Mining & Development Company, Tirapata, Peru.

Owing to special geological conditions, the summit and eastern slope of the high Andes north of Lake Titicaca have been covered with gold-bearing gravel, either moraines or ancient river gravel, with occasional quartz veins containing gold. The Inambari flows parallel with the main range of the Andes, and the summit separating it from the Tambopata River, on the east, is covered with a gold-bearing gravel. The formation is cut by a series of gold-bearing quartz veins, the most important of which is the Santo Domingo vein.

Inambari River and its tributaries rise in or near the gold-bearing deposits or in a slate formation containing high-grade quartz veins. These tributaries have their source at elevations ranging from 15,000 to 18,000 ft., and they flow into the Inambari at 2,000 to 3,000 ft. elevation, within a distance of 40 miles. They are swollen in the rainy season, and the gold is flattened out and carried through these box canyons, which act as sluice boxes with poor riffles. Most of the gold is therefore deposited along the bed of the main river or in the bars and banks during the flood season.

Along the banks of the Inambari, between the high- and low-water mark, are hundreds of acres of "gold farms." These consist of riffles formed by placing flat stones on edge and normal to the flow of the river. The riffles are held securely between rows of large stones, placed about six feet apart and wedged securely on a bed of fine sand, as shown in the accompanying illustration. During the rainy season the "farms" are covered with water and fine particles of gold are caught in the riffles. When the river subsides, the riffles are taken out and the fine sand is panned in wooden bateas. Many Indians are thus occupied for two or three months a year. Actual yield of gold per square yard has not been determined, but the fact that the work continues year after year shows that it must be profitable. A team of eight men, working on a bar near the power plant of Inca Mining & Development during the dry season of 1930, averaged an ounce of gold per day.

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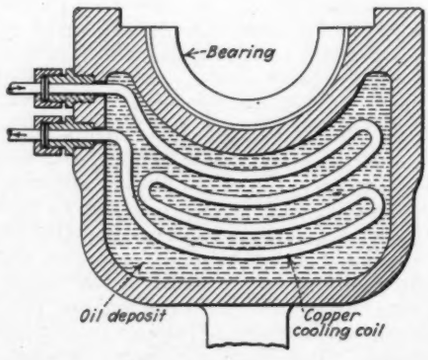
Cooling Coil Prevents Overheating of Bearing

AT THE power house of the New Cornelia branch of the Calumet & Arizona Mining Company, at Ajo, Ariz., considerable trouble was experienced with the end bearing of a small steam turbine, driving a high-pressure boiler feed pump. Its proximity to the hot turbine body resulted in excessive bearing temperatures, necessitating frequent changing of bearings, with consequent shutdowns. To remodel the bearing shell and install a water-cooling system, with which a direct cooling of the bearing could be effected, were impossible, owing to the small dimension of the bearing proper and case. Ultimately, the only practical remedy advisable was to find means to cool and keep at an even temperature the lubricating oil stored in the deposit provided in the bearing case. This was accomplished successfully by placing a small copper pipe coil within the oil storage deposit, as shown in the accompanying sketch. The coil is attached to the wall of the bearing case by two special connections, each consisting of a brass spud and nut, which also serve as the inlet and outlet connection for the cooling water. With the described installation the bearing temperature is kept well below the critical point. Continuous pumping service is thus assured.



Use of Ore Guides

Roland Blanchard

ORE GUIDES that are infallible cannot be established in a district until the last of its ore has been found; but in districts where development has been carried on over a period of years, and where parts of the ground have been thoroughly cut up, as in the older and more active mining camps, certain ore controls may be established that have been proved to be nearly invariable for the ground dissected, that leave little to the imagination for that particular ground, and that constitute the firmest basis for guiding exploration into adjacent poorly explored or wholly unexplored areas.

To be practicable, ore guides must conform to the following requirements:

1. They must be based upon some simple relation to the ore, such as the association of orebodies with a certain porphyry dike, fracture zone, or limestone bed. As a general working principle, subject to few modifications, the more involved the reasoning back of an exploration program, the less likely is that program to yield ore.

2. They must be so clearly defined and so easy to grasp that the mine foreman or shift boss will have no difficulty in comprehending and applying them. The day for the highly technically phrased report, learned and mysterious in tone, has passed. The geologist's recognized function today, be he consulting or mine geologist, is to simplify, not complicate for the operating staff, the problem of finding ore. Unless the major ore controls are so simply defined that the more responsible staff members engaged in operations underground are able to recognize them readily and grasp their significance, a good chance exists that factors important in ore discovery will be overlooked.

3. Ore guides must be larger and easier to find than the ore; otherwise it may cost more to find the guide than to find the ore itself. The pegmatite with green feldspar, which serves as forerunner to the great Broken Hill lode (Australia), is an excellent guide, since its presence signifies approach to the lode. The envelopes or "shells" of sericitized porphyry that surround the disseminated porphyry copper orebodies in certain districts likewise are excellent guides in such districts, because usually they are two or three times as large as the ore, and the more important ore occurs entirely within them. The veins of native sulphur associated with the copper orebodies at the Britannia mine, on the other hand, are poor guides, because the volume of ore exceeds the volume of sulphur many hundred times, the sulphur veins do not necessarily exist where the ore exists, and the veins, even when present, frequently are not found until the ore itself has been disclosed.

4. The major guides should be clearly distinguished as long-range and short-range guides, so the operating management may be in position to appraise the risk, and apportion expenditures accordingly. At Bisbee, for example, manganese at the surface in association with fissure silicifications is regarded as a guide to copper ore in the limestone beneath. A large surface area with prominent manganese showings corresponds usually to a large ore area, whereas a surface area with small and spotty manganese showings corresponds usually to small and spotty ore. The manganese showings occur as much as 1,800 ft. above the ore, and in many instances play cut in depth before the ore is reached. Since they serve only as general guides to the ore areas, they are termed long-range guides. On the other hand, the larger occurrences of hematite are rarely more than 300 ft. from important ore, and nearly always touch that ore at some point. Since these hematite bodies lead directly to ore within a few hundred feet, they are termed short-range guides.

5. The guides should be demonstrated *facts* of ore occurrence that will stand without the crutch of theory to support them. Many ore occurrences may be better understood in the light of geologic theory. But when an exploration program becomes based to an important degree upon theoretical considerations, it is usually foredoomed to failure. One proved fact of ore association, such as the fact that the ore in a given district actually does occur repeatedly in a certain limestone horizon, or in another district occurs consistently a certain distance beneath the old erosion surface regardless of character of rock involved, is worth a dozen theories of where the ore ought to occur.

Though numerous ore guides exist in every mining district, the dominant guides usually may be reduced to three or four major ore controls so simple that even the miners have no difficulty in recognizing them. In favored districts a single major guide often dominates. Thus, at Christmas and San Pedro most of the important orebodies touch somewhere along the "marble line"; that is, along the imaginary line between the garnet zone and the marbleized and unaltered limestone lying beyond. Prospecting the marble line there would have disclosed most of the commercial ore produced by the mines to date. At Pilares the more important orebodies lie within 75 ft. of the outer edge, or periphery, of the 1,000x2,000-ft. fractured oval; prospecting this outer zone would likewise account for probably 85 per cent of the mine's production. At the O. K. mine, near Milford, Utah, the orebodies in the monzonite are associated with small quartz veins that make out from a central plug or cylinder of quartz; and the ore decreases irregularly but rapidly with distance from that central plug. These examples illustrate the simplicity to which prospecting may be reduced in especially favored districts.

IN some districts the problem is not so simple. In one of the larger garnet copper producers of the Southwest, prospecting the marble line would have yielded only a small percentage of the total garnet ore; some of the richest oreshoots were embedded deep within the garnet without touching at any point the marble line. The explanation is that at Christmas and San Pedro mineralization took place under comparatively quiet conditions, and the sulphide orebodies were deposited without distubance in the reducing zone at the outer edge of the oxidizing zone—in other words, at the outer edge of the garnet-epidote zone, along the marble line. At the larger garnet district referred to, turbulent conditions prevailed throughout the period of ore deposition. Though some of the sulphide ore began depositing along the marble line, disturbances occurred which crushed and broke open the garnet areas; and the ore still in solution penetrated and was precipitated more or less at random within the garnet zone itself.

From the foregoing the fact is evident that ore controls established as dependable in one district may be wholly misleading in another district, even though the same ore mineral occurs at both places and the same type of deposit is involved. Because bends concave to the footwall of a vein are the ore localizers at one place, the assumption is not warranted that bends concave to the hanging wall may not be the ore localizers at some other place, even

within a single district. Differences in the character of the faulting movements may readily account for this seeming discrepancy, as has been discussed and illustrated with diagrams by Hulin[1]. Emmons[2] has quoted from some unpublished data of my own, showing the results of checking up the prospector's conviction that vein intersections or junctions are the most favorable places to look for rich oreshoots.

Out of 137 cases that have come under my observation in which both legs of the vein carried commercial ore, 74.45 per cent proved richer at the intersection or junction; 11.68 per cent showed no appreciable change; and 13.87 per cent proved poorer at the junction. In this last class, fifteen deposits, or 10.95 per cent of the total cases under consideration, showed noncommercial values at the junction, and seven of the fifteen, or 5.11 per cent of the total, were entirely barren, even though profitable ore had been extracted from each of the veins near by.

Again, the fact that a formation or type of rock is favorable or unfavorable to ore in a given district does not necessarily suggest that it is similarly favorable or unfavorable in another district. In various parts of western North America limestone is the ore carrier; shales and slates are so barren that often they are not considered worth prospecting. Yet in various parts of Australia the despised shales and slates carry large, rich oreshoots, Mount Isa being the outstanding recently discovered example. Nor can it be argued that the shales and slates are here mineralized because limestone is absent; for in several places in northwestern Queensland the ore solutions have passed by the limestone to deposit almost exclusively within the shales and slates. Even within the favored limestone belt of southwestern United States, at the Lookout property, in the Black Range, in New Mexico, the limestone traversed by the ore solutions shows only low-grade mineralization; whereas, an 18- to 20-ft. bed of the usually inhospitable quartzite, lying beyond, carries the commercial orebodies. These examples illustrate the danger of projecting too far or with too much assurance the ore habits of a given district, deposit, or occurrence.

USUALLY, each district presents examples of individual ore habits which must be in large part mastered before exploration programs may be intelligently and economically laid out. Such effective (though admittedly incomplete) mastery may require from several weeks in simple cases to several years in districts whose geology is complicated, as at Bisbee, Ely, Tintic, or Broken Hill; but during that period progress will be made which will continually reduce the exploration hazards. For guidance of the operating staff, as well as to guard against unsound deductions on the part of the geologist himself, the data on which conclusions are based should distinguish clearly between (1) agencies within the district that have a proved and direct bearing upon the finding of ore; (2) agencies within the district not yet fully proved but which seem likely to have such bearing; (3) agencies which have proved effective as ore guides in other districts under conditions closely resembling those in ground being explored. Manifestly, the third group is least reliable. Its inclusion is justified chiefly because of the resulting tendency to sharpen observation and maintain alertness in all concerned.

IN ferreting out the less obvious guides, the temptation to surrender simply because a problem is difficult and seemingly insoluble must continually be combated. Shortly after the World War a certain valuation engineer declared to me that after many years of familiarity with the Bisbee limestone deposits he had concluded that the only way limestone ground could be appraised in the district was on the basis of proximity to Sacramento Hill; any other method was hopeless. On that assumption, ground would be regarded as decreasing uniformly in value outward into the limestone from the main ore locus, Sacramento Hill. This sort of nonsense implies physical and mental laziness on the part of the person making the statement. To work out detailed ore controls in ground like that at Bisbee so as to permit proper evaluation of the various limestone areas is no simple task; but the fact that it has been done proves that it may be done again.

WHEN compiling for discussion in a report the ore guides of a district, one should first create a perspective, or mental framework, upon which to hang the various details. A private report on an Arizona property which I have seen drew an analogy between the deposit and an ocean liner. Commercial ore, dependent upon secondary enrichment, was represented as the deck and that part of the hull above water line; unenriched primary ore, too low in grade to be profitably extracted, was represented as the hull below water line. Although more than a dozen detailed guides were subsequently discussed, the reader was not confused, because each guide was referred to its respective position above or below water line, and likened to some well-known feature of the ship, such as the smokestack or engine room. Shift bosses are usually able to visualize the commercial aspects of a deposit when thus portrayed.

Discussion of any specific guide should be brief. It should contain a clear, full statement of the relation of that guide to the problem of finding ore, together with pertinent applications. Beyond that everything should be ruled out, however tempting the occasion for the author to air his ideas or knowledge. Ordinarily, for such discussion two hundred to five hundred words suffice; rarely are more than a thousand words justified, including references to illustrative cases. If facts alone are presented, as distinguished from ideas and theories, and brevity of style is cultivated, prolongation of the discussion of a single feature beyond six to eight hundred words is usually difficult. Should the author feel that discussion of geologic theory is essential, the appendix constitutes an appropriate cemetery for its interment. That the more reports one writes on the subject of ore finding, the less need does there seem to be for discussion of theory, is a striking fact.

The number of guides to be discussed varies with the scope of the report. Fewer usually will be available or required for an isolated, moderately small deposit than where a major mining district is involved. In a certain silver-lead district in the andesite belt of New Mexico which I have examined, oreshoots occur wholly within a 2-mile length of the X fault zone, which is variably from 40 to 110 ft. wide. Within that zone commercial ore is restricted to sections which exhibit pronounced concave bends with respect to the footwall. Within those bends ore is still further confined to the more highly brecciated areas. And within the brecciated areas the richest ore occurs where the andesite is strongly altered to chlorite with minor epidote. Leached products above the ore are locally helpful in directing exploration, but this guide is of limited application because (1) oxidation does not penetrate below the 150 level; (2) most of the surface ore has been mined; (3) the ore is lenticular down the dip, so that an oreshoot does not necessarily extend upward to the oxidized zone. The major guides in this case are:

1. X fault zone.
2. Concave bends with respect to the footwall.
3. Brecciated parts of the bends.
4. Highly chloritized areas within the breccia portions.
5. Leached capping (local).

Several minor guides dealing with the beginning and ending of veins within the chloritized areas need to be discussed, but so far as the general operating staff is concerned the guides enumerated suffice. For the Ely district I used the classification delineated in the following:

General Guides—three headings.
Guides Within the Porphyry:
- A. Structural Features—five headings.
- B. Expression of Mineralization Above the Ore—two headings.

[1]Carlton D. Hulin. *Engineering and Mining Journal*, Vol. 127, p. 228, 317. Also, "Structural Control of Ore Deposition." *Econ. Geol.*, Vol. 24, No. 1, January- February, 1929.

[2]W. H. Emmons. Vol. 76, p. 308, *Trans.* A.I.M.E.

Guides Within the Limestone:

A. Structural Features—thirteen headings.
B. Expression of Mineralization Above the Ore—eight headings.
C. Expression of Mineralization Below the Ore—four headings.

Miscellaneous—seven headings.

Work done in the Ely district since my visit in 1928 presumably has added to the guides in certain divisions and probably eliminated others that were tentatively included. A list of ore guides once cataloged does not remain stationary so long as exploration continues; imagination remains active, and application and search for new guides are energetically enforced.

With the current guides established for a given mine or district, their application in mine exploration has been found in some instances most effectively carried out through discussion in conference, at which the presence of all members of the operating staff down to and including mine foremen is desirable. Each member is generally handed, a week in advance, the list of prospects to be discussed, and each is required to submit in writing his conception of the favorable and unfavorable factors affecting a given prospect. Mere verbal discussion is unsatisfactory; it permits shirking, and often degenerates into irresponsible and flippant quibbling. The written statement, on the other hand, fixes responsibility, compels sound reasoning, and conduces to sustained, clear thinking. By the time the favorable and unfavorable aspects of a prospect, as reasoned out by the full operating staff, have been collected and threshed over in conference, each member has obtained a vivid conception of why that prospect is to be run, what its chance is for success or failure, and what guides or ore localizing factors he must watch for as exploration progresses. Because each member has contributed something, each feels a personal interest in the outcome.

AT times the most carefully thought-out program will be vitiated by accident or by factors that could not have been reasonably foreseen. In the limestone deposits of one Southwestern copper district, for example, certain surface evidences of mineralization occur that are clearly associated with ore deposition. Either by direct or devious routes those evidences have been found to lead downward to ore. But in several instances the orebodies have been cut out by an intrusion of post-ore rhyolite, which, with true irony, failed to destroy the evidence of vigorous mineralization above the ore. To have exploration encounter such a condition when everything pointed to a large, profitable orebody cannot but be disheartening. But since none of us is omniscient, we must become reconciled to the fact that in carrying out any prospecting campaign, disappointments will ensue—sometimes through oversight on our part, sometimes through the vagaries of mineralization which were not subject to analysis prior to actual exploration. A certain allowance must be made for this, particularly when prospecting limestone areas, where ore is characteristically erratic in behavior and occurrence. But that does not mean we should go to the other extreme, and fail to avail ourselves of the most carefully reasoned program that is possible at the time.

As Augustus Locke once stated to me[3], we must remember that we are not competing with a technique that is 100 per cent perfect. The science of finding ore is probably not more than 35 per cent efficient today. If we improve that efficiency 10, or even 5 per cent, we are accomplishing a great deal.

Mistakes that result from unsound deductions or lack of thoroughness in reasoning and applying existing data may be largely eliminated where proper distinction is insisted upon between ascertained fact, reasonable probability, and the more remote conjecture; and where conscientious attempt is made to recognize and acknowledge the degree of doubt involved in using guides not yet securely established in a district. Mistakes caused by the undisclosed vagaries of mineralization are not as immediately subject to control. Usually they can be reduced only in the proportion that such vagaries reveal themselves as distinct district habits. The important point to be kept in mind in any district or with any deposit is that although a part of the ground may have been rather thoroughly cut up, and its ore habits ascertained, other large, well-mineralized areas have usually been but little explored, and concerning their ore habits little has been definitely established. To assume that most of the guides found dependable in proved areas will apply in adjacent untested ground is reasonable; but so long as ore continues erratic in occurrence, constant watch and diligent search must be maintained, both for local exceptions and for new, broad ore controls.

[3]Augustus Locke, oral communication. Acknowledgment for several ideas here discussed is due Mr. Locke, upon whose staff many years ago I acquired my first training in the use of ore guides.

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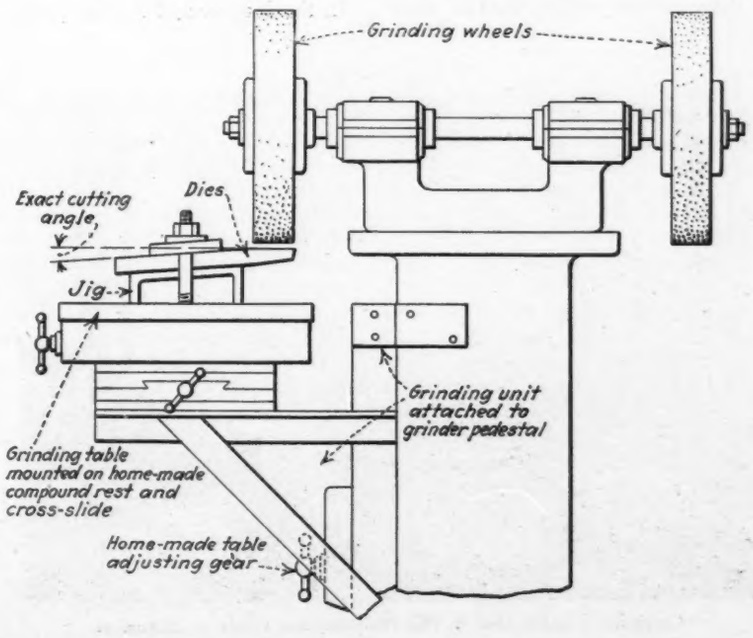
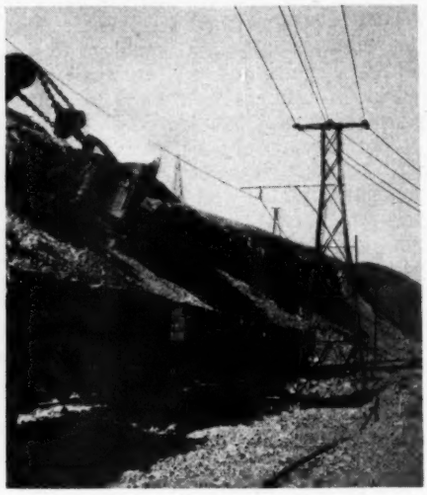
Cutting Tools Are Cheaply Reconditioned

TO AVOID the unsatisfactory manual grinding of pipe-threading dies and other cutting tools, and to render them serviceable at a lower cost, Charles R. Clarkson, master mechanic at the Hayden smelter of the American Smelting & Refining Company, Hayden, Ariz., built the attachable grinding unit shown in the accompanying sketch. The machined table is mounted on a home-made compound rest and cross-slide that rest on a frame made of channel and angle iron, which is fitted with an adjusting gear and secured to the grinder pedestal. Jigs are provided for the various grinding operations, to expedite the correct setting up of tools to be ground and to make possible the simultaneous grinding of several dies or tools at a material saving.



Electric Ore Haulage



The contact wire is offset 10 ft. to clear shovel boom

L. W. Birch

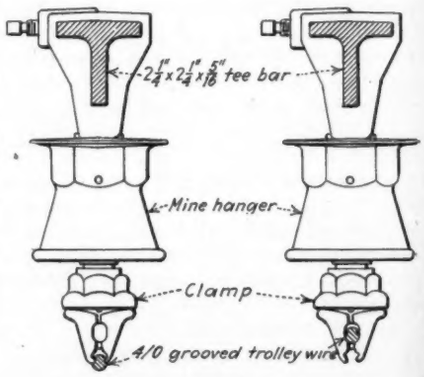
Engineer, Transportation Department, Ohio Brass Company, Mansfield, Ohio, U. S. A.

IN SPITE OF many obstacles, economies incident to mine electrification were effected recently in the erection of an overhead system at the Bingham mine of the Utah Copper Company. Grades of 4 per cent, curves on railroad bridges ranging from 12 to 24 deg., portable track sections, settling fills, and blasting were problems met and satisfactorily solved. The 65-mile electrification was an illustration of heavy electric traction principles applied to ore haulage. In the classification and crusher yards, catenary overhead was employed; on the mine benches and switching tracks, direct suspension was necessary; and on portable sections and new waste dumps, special offset construction was required.

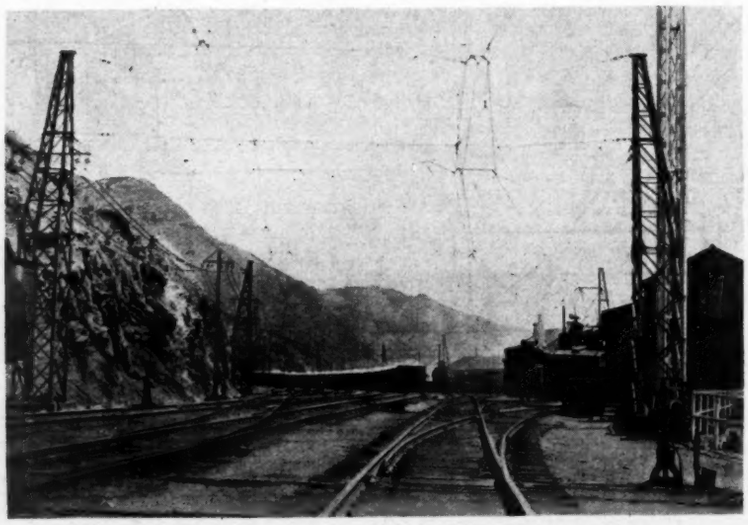
In 1924, the car dumper yard area, aggregating 7 miles of track at Magna and Arthur, was electrified with 600 volts d.c., and 600 cars of ore were handled to and from the car dumps daily by two 80-ton electric locomotives. This service had heretofore been furnished with steam switching locomotives, the stand-by expense of which made unloading costs heavy. In less than two years the savings from electric operation absorbed the initial cost of electrification. These gratifying results hastened developments at the mine and brought about virtually complete electrification in five years.

A careful survey of the power requirements revealed that the proposed mine locomotive would draw a maximum current of 900 amp. and an average of 300 amp. Feeder lines and load centers were determined accordingly. With these current values, contact wire capacity could be held within the limits of a 4/0 copper conductor. As a consequence, a single 4/0 grooved, hard-drawn, copper contact wire was used and has proved satisfactory, with the exception of possibly one type of service. On some of the severe grades the contact wire diameter has decreased appreciably, owing to high-current collection causing burning. The life of the contact wire at these points is averaging about 25 per cent of the expected life on the levels.

In the Magna and Arthur yards, and also at the classification yard in Bingham, catenary construction was used. This type of construction was chosen for the reason, largely, that these yards were level, permitting wide pole spacing. The catenary construction provided clearance in the yards, and, by the use of steel towers in the classification yards, economy in construction cost was attained. A simple catenary, consisting of a $\frac{7}{16}$-in. steel Siemens-Martin messenger cable tensioned to 2,000 lb., and a 4/0 grooved copper contact wire supported from the messenger wire by means of flexible hangers, made up the system. The ratio of conductivity of steel messenger to copper contact wire is so high that only about 2 per cent of the current is carried in the messenger wire; and consequently, from the standpoint of feeding, the messenger wire was not considered as a current carrying medium. Likewise, it was not considered as a hazard from the standpoint of the flexible hanger loop burning, inasmuch as practically no current is transmitted from messenger wire to hanger loop. Pole spacings of 150 ft. were maintained at Magna and Arthur, greater spacings being used in the classification yards.

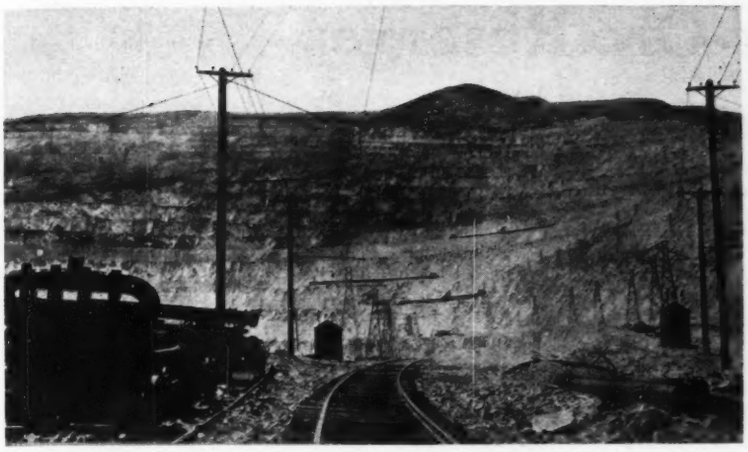


Dual trolley clamp and insulated hanger used on the mine benches



Catenary construction in the classification yards at Bingham

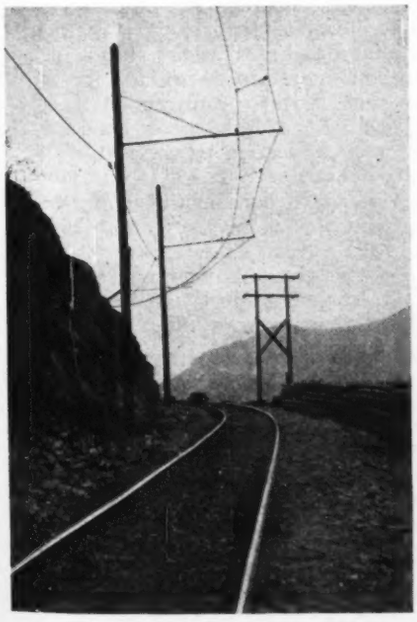
The main-line haulage system was equipped with direct suspension overhead. This type of overhead was selected on account of the many curves in the track, the location of poles, and the additional mechanical stresses incident to the use of catenary construction. The down-hill side of the right-of-way had to be kept clear for the operation of snowplows, and consequently all supporting structures were placed on the hill side of the track. This necessitated heavy bracing of the supporting poles on curves, where the stress from the contact wire pushed against the pole



Part of the Bingham mine; portable steel overhead supports are seen just beyond the poles in the foreground

rather than pulled away from it. The backbone, to which pull-overs were fastened, was attached to the pole where the curve stresses were away from the pole, and to the outside of the bracket arm where the curve stresses were toward the pole. This construction complicated the overhead to a certain extent, but through the use of longer bracket arms, even the 18- and 20-deg. curves were satisfactorily handled.

On the waste dumps considerable settling takes place from day to day, and, to preserve the alignment of the contact wire, the supporting structures had to be attached to extended ties. On these sections, as well as on the benches where ore is loaded into cars, an offset contact wire was required for the purpose of clearing the electric shovel booms. Special side arm collectors, installed on each side of the locomotives, were required for current collection, the length of the collector being such as to permit the contact wire to be offset 10 ft. from the center of the track.



All poles are on the hill side of the tracks on account of snowplow and spreader operations

On the benches two types of supporting structures are used for the support of the contact wire. One type consists of a tubular-steel structure to which is attached a standard tee-bar bracket arm, the upright column being cast into a heavy block of concrete that makes the pole self-supporting. This block of concrete has a heavy eyebolt cast in the front. When it is necessary to move the track toward the hill, the various supporting structures can be pulled toward the track by attaching chain falls or a line from a winch to the eyebolts. Sections requiring a 5,000-volt supply line to the electric shovels employ a structural steel tower built to carry both the supply line and the 750-volt contact wire for the locomotives. The structural tower is weighted at the bottom with rock and is moved with the track in a manner similar to that devised for the tubular structure.

Two types of trolley suspension are used on the benches. The first type consists of an attachment made by fastening two ends of a light piece of strand to the contact wire, the attachments being made within 3 to 4 ft. of each other. The center of this strand is then suspended from an insulator on the bracket arm. In moving the portable structures, the entire line cannot be moved at one time; consequently, increased tension and slack develop between structures. The purpose of the suspension just described is to permit the contact wire to slide in the direction of the line during the moving of a structure. The other type of support, which is shown in an accompanying illustration, consists of a dual trolley clamp and insulated hanger. Normally, the trolley clamp grips the contact wire in the groove. When the portable structures are to be moved, a few turns of the nut of the trolley clamp, as shown to the left in the illustration, will open the jaws of the clamp and permit the contact wire to be pushed into the recess above. This recess has a diameter considerably greater than that of the contact wire. The clamp is then tightened slightly and the wire held loosely in the enlarged recess. When the portable poles are moved, the contact wire is free to slide in the direction of the line; thus excessive tension or slack in the wire, permitting it to drop to the ground, is avoided.

The first type of suspension is being replaced by the second type, inasmuch as the original type required steadying at many points, as well as pull-overs for curve track. The second type does not require steadying, and, with a rigid suspension of contact wire through the trolley wire clamp and hanger, a pull-off is not necessary.

On the railway bridges encountered in this electrification, the contact wires were supported with light I-beam structures. The V-suspension, described first for portable structures, was used in practically every item on the bridge electrification.

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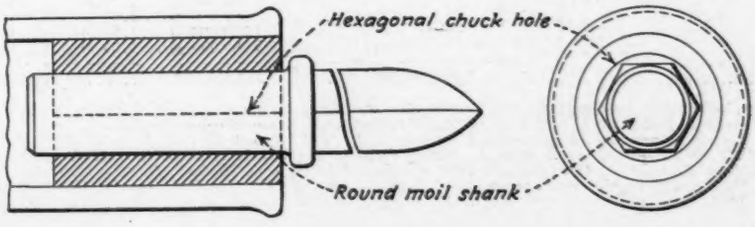
Jackhammers for Hitchcutting

TO CUT timbering costs, the substitution of manual hitchcutting with modern, specially designed compressed air operated tools is essential. At many properties, however, sufficient tools of this kind are not always available, and to meet the situation light jackhammers, with their ratchet mechanism removed, are used instead. To avoid taking apart each drill to remove the ratchet, all moil shanks, of octagonal or hexagonal drill steel, must be rounded in the drill sharpener so as freely to revolve in the hole of the hexagonal chuck bushing, as shown in the accompanying sketch. With this method, which is successfully applied at the Miami Copper Company, Miami, Ariz., the purchase of additional special hitchcutters has been avoided and an economy in the use of drill steel effected, by converting worn and useless jackhammer or stoper steel into moils, with the minor alteration described in the foregoing.



World Copper-Ore Reserves

Percy E. Barbour

Consulting Mining Engineer, New York

TO COMPILE a final total of the world's copper-ore reserves is, of course, impossible, but many interesting figures have been published during the last year that add greatly to our information and indicate a large increase in known ore supplies. The table presented herewith is a casual compilation of these estimates as they have variously appeared. It contains nothing original, is not comprehensive, is not final, and is only semi-official. It omits many important producers and producing districts whose figures are not available, including Alaska, Montana, Michigan, Tennessee, United Verde Copper, and Rio Tinto non-porphyritic, to mention only some of the more important.

The amount of drilling and exploration going on in Africa makes it certain that almost all the African figures will be revised upward. Sir Edmund Davis, chairman of the Bwana M'Kubwa company, last summer stated that "on the basis of the new estimates, total ore reserves of the Rhodesian copper properties would seem to be more than 400,000,000 tons of about 4 per cent copper ore." This checks closely with the table. Geology indicates, however, that enormous bodies of low-grade ores, like the porphyries in this country, will not be found there, because the ore does not fringe out into leaner material.

The appearance of Bagdad Copper, in Arizona, with 48,000,000 tons of ore shows that there are still mines to be developed in this country. The appearance of a large tonnage in Uganda shows the African copper horizon is widening. Addition of 9,000,000 tons in Australia is the result of increased mechanical and metallurgical efficiency which is turning junore into commercial ore, although not all of the low-grade tonnage given is commercial ore at present.

Comparison of the total tonnage indicated by this compilation with the last one published by the American Bureau of Metal Statistics, the most comprehensive table published heretofore, is striking. The development of huge reserves of high-grade sulphide ore in Chile is of outstanding importance. The figures are authentic.

Three South African mines—Roan Antelope, N'Kana, and Mufulira—are now preparing for stoping. The mines are far ahead of schedules, thus assuring readiness to furnish ore for the mills as soon as their construction is completed. Roan Antelope is expected to go into production by the end of 1931 and N'Kana early in 1932. The cost of Rhodesian copper is not likely, for years at least, to be anywhere near as low as some newspaper writers would have people believe. No one should be misled into fear of a flood of cheap South African copper wrecking the American copper industry.

A long period of time always elapses between first production and ultimate low costs. In 1929, Utah Copper produced at a total net over-all cost of 5.401c. per pound of copper, but how long did it take to achieve that record? Nearly thirty years. Moreover, it should not be overlooked that the Chile Copper Company's mine at Chuquicamata has more copper metal in its orebody than all the combined ore reserves thus far blocked out in Africa. The publication of the new estimates of Chile reserves caused no excitement, astonishing as they are.

Finally, although no need is apparent of worrying about an unusable flood of copper, there is also no ground to worry about where the next two generations are going to get copper. It is in sight.

COPPER-ORE RESERVES OF THE WORLD

	Former Data			Latest Data		
	Year	Tons	Grade	Tons	Grade	Copper Content, Tons
United States:						
Utah Copper	1929	640,000,000	1.07	640,000,000(a)	1.07(a)	6,848,000
Nevada Consolidated	1929	273,500,000	1.47	300,000,000(g)	1.40(e)	4,200,000
Phelps Dodge:						
Burro Mountain	1930	11,725,000	1.95	11,725,000(b)	1.95(a)	229,000
Morenci	1930	233,000,000	1.20	245,000,000(b)	1.10(b)	2,695,000
Copper Queen	1930	23,500,000	1.63	20,675,000(b)	1.90(b)	393,000
New Cornelia	....	.....	....	1,829,000(b)	4.20(b)	77,000
	....	.....	....	113,250,000(b)	1.30(b)	1,472,000
Inspiration	1925	96,011,000	1.40	96,011,000(a)	1.40(a)	1,344,000
Miami	1929	97,392,000	0.95	97,392,000(a)	0.95(a)	925,000
Consolidated Coppermines	1929	30,000,000	1.10	32,000,000(c)	1.10(a)	652,000
Bagdad	....	.....	....	48,000,000(k)	1.20(e)	576,000
United Verde Ext	1929	625,000	7.50	625,000(a)	7.50(a)	47,000
Canada:						
International Nickel	1930	202,620,000	1.95	202,620,000(c)	1.95(c)	3,963,000
Hudson Bay	1929	18,000,000	1.71	18,000,000(a)	1.71(a)	308,000
Noranda	1930	3,426,000	7.53	3,426,000(a)	7.53(a)	258,000
	1930	3,000,000	2.00	3,000,000(a)	2.00(a)	60,000
	....	.....	....	238,000(c)	1.00(c)	2,000
Granby	1929	14,342,000	1.81	14,342,000(a)	1.81(a)	260,000
Sherritt Gordon	....	.....	....	5,254,000(c)	2.50(c)	131,000
Britannia	....	.....	....	10,000,000(c, e)	1.30(c, e)	130,000
Amulet	....	.....	....	527,000(h)	3.00(h)	16,000
Mexico:						
Phelps Dodge	1930	3,580,000	2.70	3,500,000(b)	2.70(b)	94,000
Nicaragua:						
Tonopah Nicaragua	....	.....	....	1,500,000(l)	5.00(l)	75,000
Cuba:						
Matahambre	1929	965,000	5.00	965,000(a)	5.00(a)	48,000
Chile:						
Chile Copper	1921	688,630,000	2.12	684,000,000(o)	2.12(o)	14,500,000
				316,000,000(o, e)	4.00(o, e)	12,640,000
Braden	1929	234,798,000	2.18	234,798,000(a)	2.18(a)	5,118,000
Andes	1924	137,400,000	1.51	137,400,000(a)	1.51(a)	2,075,000
Africa:						
Belgian Congo:						
Katanga	1928	85,979,000	6.41	85,979,000(a)	6.41(a)	5,511,000
Transvaal:						
Messina	1929	910,000	3.04	1,155,000(o)	3.04(o)	35,000
Uganda:						
Kilembe (Tanganyika Conc.)	....	.....	....	330,000(b)	4.50(b)	15,000
Rhodesia:						
Bwana M'Kubwa (N'kana)	1929	45,000,000	4.20	200,000,000(d)	4.00(e)	8,000,000
Roan Antelope	1929	75,000,000	3.43	100,000,000(i)	3.43(e)	3,430,000
Mufulira (Rhodesian Selection Trust)	1929	40,000,000	4.70	60,000,000(i, d)	4.50(e)	2,700,000
N'Changa	1929	59,000,000	3.90	64,641,000(q)	3.90(e)	2,521,000
Chambishi (Rhodesian Selection Trust)	....	.....	....	25,000,000(j)	3.80(j)	950,000
Baluba (Rhodesian Selection Trust)	....	.....	....	25,000,000(j)	3.20(j)	800,000
Rho. Congo Border Conc	....	.....	....	60,000,000(n)	8.00(n)	4,800,000
Kanshanshi	....	.....	....	8,000,000(f, e)	4.15(f, e)	332,000
Spain:						
Huelva, Rio Tinto (porphyritic)	....	.....	....	5,000,000(m)	1.40(e)	70,000
India:						
Indian Copper	1928	756,000	3.78	756,000(a)	3.78(a)	29,000
Australia:						
Mount Lyell	1929	1,807,000	4.51	1,807,000(a)	4.51(a)	82,000
				2,500,000(p)	2.25(p)	56,000
				500,000(p)	2.00(p)	10,000
				1,000,000(p)	1.50(p)	15,000
				5,000,000(p)	1.00(p)	50,000
Total	....	3,020,966,000	....	3,888,500,000	.....	88,542,000

Data in first three columns from 1929 Year Book of American Bureau of Metal Statistics, with correction for International Nickel. Tons of 2,000 lb. "Grade" indicates percentage of copper in ore.

(a) American Bureau of Metal Statistics. (b) *E. & M. J.*, April 24, 1930. (c) *Ibid.*, June 23, 1930. (d) *Ibid.*, Jan. 9, 1930. (e) Estimated. (f) *E. & M. J.*, Aug. 9, 1930. (g) *Ibid.*, Nov. 24, 1930. (h) *Ibid.*, Oct. 23, 1930. (i) *Ibid.*, Sept. 25, 1930. (j) *Ibid.*, Aug 23, 1930. (k) *Ibid.*, July 24, 1930. (l) *Ibid.*, May 23, 1930. (m) *Ibid.*, May 8, 1930. (n) Private communication. (o) *E. & M. J.*, Jan. 12, 1931. (p) *Ibid.*, Jan. 26, 1931. (q) *Ibid.*, June 7, 1930.

New Alignment Chart

Tri-State Engineer Devises Method of Readily Showing Relationship of Economic and Metallurgical Factors Involved in the District's Operations

IN EXPRESSING data in the form of tables and charts, the engineer frequently encounters the obstacle of being unable to express as many variables as he wishes. This circumstance, states F. J. Cuddeback, mining engineer, Consolidated Lead & Zinc Company, led to investigation of methods allowing the expression of more than two or three variables. Alignment charts are the answer to such a problem. These charts not only enable the presentation of several variables but are also much more accurate than the usual methods of presenting data graphically.

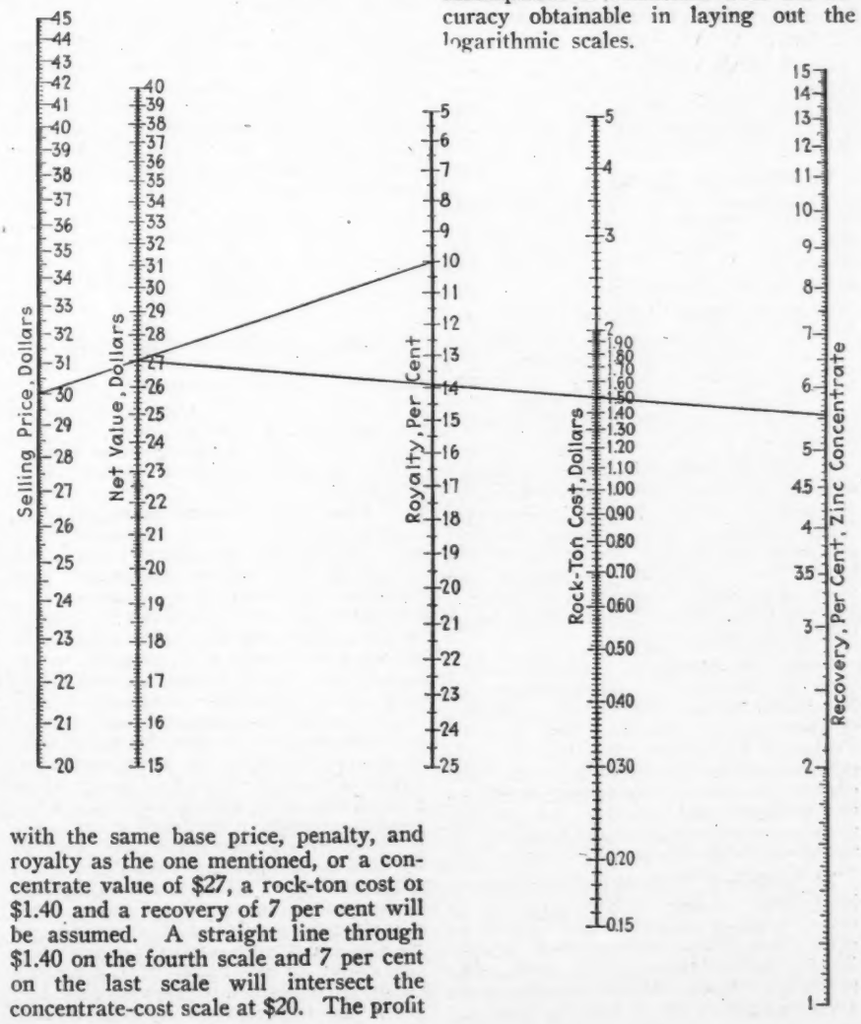
The accompanying alignment chart, showing the relation of concentrate selling price, concentrate value, royalty, rock-ton cost, and recovery, appears complicated because five logarithmic lines are employed instead of the usual three. However, a little explanation will show that its application is comparatively simple.

A straight-edge, about as long as the diagonal dimension of the chart, is required. The fine lines connecting the vertical scales represent the position of the straight-edge in the following example: Assume a mine operating under the following conditions: (1) a base price for zinc concentrates of $31; (2) a royalty of 10 per cent; and (3) a rock-ton cost of $1.50. In the first step the selling price of zinc concentrate is figured mentally by taking into consideration the base price and grade of concentrate produced. In this case assume a grade of 59 per cent, so the selling price will be $30 per ton. Then connect $30 on the first scale to 10 per cent on the third or royalty scale. At the point where the straight-edge intersects the second scale the net value per ton of zinc concentrate, or $27, may be read. Then a straight line through this same point on the second scale, and $1.50 on the fourth or rock-ton scale, intersects the last scale at 5.55, which is the recovery in terms of zinc concentrate this mine must attain before profit starts. In other words, this is the point at which the mine would just break even. This may be more clearly understood, perhaps, if the second scale be considered as concentrate-cost in the second step of using the straight-edge. If the concentrate cost equals the net value per ton of concentrate, the mine would just break even.

Now change conditions slightly and assume that the highest possible recovery at this particular mine proves to be 5 per cent. Then the operator would naturally be interested in knowing what rock-ton cost would have to be attained before profit could be possible. By laying a line from 5 per cent on the recovery scale to $27 on the net-value scale, one finds that a rock-ton cost of $1.35 would be necessary. If a cost lower than $1.50 should be impossible at this mine, one may also determine what the base price of zinc must be to enable the mine to make a profit on so low a recovery.

Although this chart was not designed to show the amount of profit, the profit per concentrate ton may be indicated by using the second line as both a net-concentrate-value scale and a concentrate-cost scale, as suggested in the foregoing, and noting the difference. For example, in the instance of a mine with the same base price, penalty, and royalty as the one mentioned, or a concentrate value of $27, a rock-ton cost of $1.40 and a recovery of 7 per cent will be assumed. A straight line through $1.40 on the fourth scale and 7 per cent on the last scale will intersect the concentrate-cost scale at $20. The profit per ton of zinc concentrate would be $7.

The accuracy of an alignment chart depends on the accuracy of the formulas upon which it is based and the care used in laying out the logarithmic scales. The latter source of error will always be present in any presentation of data graphically. This particular chart is based on the two following formulas: $V = (100 - Y)\ P$ and $C = RV$, in which V is the net value or cost of a ton of concentrate; Y is the royalty in per cent; P the selling price of a ton of concentrate; C the rock-ton cost; R recovery in per cent of zinc concentrate. There are two possible fallacies in the formulas used. One of them is that practically every zinc and lead mill produces coarse as well as flotation zinc concentrates, and consequently an average selling price must be estimated. An accurate average selling price could be obtained, but would involve more data and calculation than the purpose of such a chart would warrant. The other fallacy is that in converting the total zinc and lead recoveries into terms of zinc recovery, the common practice of doubling the lead recovery and adding it to the zinc recovery is only approximate. However, I believe that the maximum inaccuracy of using these assumptions is consistent with the accuracy obtainable in laying out the logarithmic scales.



Published through the courtesy of the Tri-State Metallurgical Association, Picher, Okla.

Personal Notes . . . Comment . . . Criticism

Bennett R. Bates has rejoined the staff of The Dorr Company, with headquarters in New York.

Robert Merlin is now with the Sociedad Minera Metallurgica Zapata Portman, Murcia, Spain.

Paul T. Bruhl left London recently for West Africa, to join the metallurgical staff of Ashanti Goldfields.

Dr. H. M. Payne was recently elected president of the Washington Post, Society of American Military Engineers.

J. C. Kinnear, general manager of Nevada Consolidated Copper, was elected president of the Nevada Mine Operators' Association at its recent annual meeting.

Charles W. Clarke has been elected president of United Verde Copper, and **R. E. Tally** vice-president in charge of mining and smelting operations, with headquarters in New York.

Nelson Dickerman, of Yuba Associated Engineers, has returned from London to San Francisco, Calif,, and will leave for Japan after a short visit to the company's headquarters.

Lucien Eaton sailed from New York for England on Feb. 16 on the "Europa." After visiting several Continental capitals, he will sail on March 20 from Southampton for Northern Rhodesia.

G. H. Rupp, manager of the mining department of Colorado Fuel & Iron, has been made chairman of the Underground Standardization Committee of the American Standards Association.

Dr. Waldemar Lindgren, professor of economic geology at the Massachusetts Institute of Technology, has been elected an honorary member of the American Institute of Mining and Metallurgical Engineers.

Woolsey McA. Johnson wishes his friends to be informed of the death, at the age of 94, of his father, Dr. C. F. Johnson, professor emeritus at Trinity College, Hartford, Conn., and well known as an engineer, inventor, scholar, and author.

J. Volney Lewis announces a change of address from 21 State St., New York, to Administration Building, Burnham Park, Chicago. He has resigned as staff geologist for foreign operations of the Gulf Oil Corporation to organize the work in geology, mining, and metallurgy for the International Exposition to be held in Chicago in 1933.

Louis Garbrecht, formerly with Tonopah Mining, American Metal, Cia. Minera de Peñoles, San Francisco Mines of Mexico, and Cia. Real del Monte y Pachuca, announces that he has reentered independent practice. He will engage in general consulting work — examination and reports on mining properties and oil lands, specializing in appraisal—with offices in El Paso, Tex.

L. T. Merrill, of Picher, Okla., reports interesting results of an analysis of seven tons of assay-sample rejects of zinc concentrates accumulated at the Picher Assay Office during 1930. The result, as follows, closely represents the average analysis of all turn-ins from the district during the year: Metallurgical analysis, per cent—Zinc, 58.000; iron, 1.700; lead, 1.520; copper, 0.060; cadmium, 0.387; sulphur, 30.837; lime, 0.670; magnesia, 0.508; silica, 4.990; carbon dioxide, 1.081; total, 99.753 per cent. Mineralogical analysis, per cent—Blende, 86.420; marcasite, 3.652; galena, 1.755; chalcopyrite, 0.180; greenockite, 0.497; calcium carbonate, 1.195; magnesium, 1.064; silica, 4.990; total, 99.753 per cent.

R. G. Hall, after visiting many important metallurgical establishments in Canada and the United States, mentioned, at a recent meeting of the A.I.M.E. at San Francisco, that the position of electrolytic zinc is being influenced by the new work at Palmerton, Pa., where zinc of an equivalent grade is being produced by vertical retorts of new design. Flash roasting, an adaptation from coal-dust firing and a rejunevation of roasting methods long ago established by Stedefeldt, was described as an advantageous method for increasing the sulphur dioxide content of roaster gases, compared with that obtainable in multiple-hearth roasters. He stated that this type of roaster is being used to some extent, multiple-hearth furnaces being modified by removing some of the hearths, thus providing larger roasting chambers. As an example, he stated that the sulphur dioxide content of gas from roasting pyrite had been increased up to 12 per cent—a higher content than was obtained by the direct burning of sulphur.

Recent Silver Proposals

Chester T. Kennan, Helena, Mont.:

1. That Congress immediately pass a law authorizing and directing the purchase from the mines in the United States of 1,000,000,000 oz. silver at $1 per ounce.

2. That said 1,000,000,000 oz. silver be coined into dollars, 50c. pieces, quarters and 10c. pieces of exactly the same weight and fineness as our present dollars and subsidiary silver coins.

3. That the United States Treasurer be authorized and directed to ship such coined silver, as fast as possible, to responsible banks in India and China and such other countries as Congress may from time to time designate, and to send a representative of the United States Treasury to each of these principal banks of deposit to oversee the distribution of the coin with a view to its becoming a common medium of exchange in those foreign countries and also to be used as medium of exchange in exportation and importation of goods. When our importers buy goods from those foreign countries they should pay for the goods with a check against this silver coin in the banks of the foreign country from which the goods come, and when an importer in such a foreign country buys goods from our country he can send our exporter a check on the silver coin, which our exporter can take to any bank and receive bank credit for it, less a small exchange rate—whatever it may happen to be, if any.

4. That silver coin so exported be redeemable in gold and circulated in the foreign countries on the same basis of value as in the United States, less customary exchange or discount, if any.

5. That the United States Treasury have, as remuneration for such services, the face value of the silver coin above its bullion value of $1 per ounce.

A. C. Daman, Denver, Colo.:

1. The immediate calling together of the financial representatives of the largest nations, to decide on an International Dollar (or other standard), which would have a uniform value throughout the world. This dollar, consisting of 50c. in silver (approximately 1 oz.), and 50c. of gold, would give an immediate demand for silver and would stabilize the value of silver, particularly in China and India. These dollars would be backed by the gold reserves of those nations underwriting their own particular issue, so labeled.

2. The increased use of metal coins, such as silver dollars, which will necessitate the immediate coinage of at least $100,000,000 in metal coins of all denominations, particularly those requiring silver. A smaller size dollar, such as the International Dollar, would make it more popular.

3. Each government should give a bonus of $5 if necessary for every additional ounce of new gold produced or mined in its own country in 1931 over that produced in 1930. This will stimulate the production of gold by making it possible to operate low-grade gold properties and to undertake new development work. Better distribution of credit will result.

4. Stimulate the production of gold and silver, particularly the former, also by practical constructive help and advice from state and governmental channels, the free testing of ores by various mining bureaus, and the use of publicity to lower the cost of the development and production of gold and silver.

Percentage Depletion

To the Editor of "E.&M.J.":

I have been asked a number of times to express some opinion as to the merits of an arbitrary "percentage depletion" as against the present method of calculating a deduction from income to cover either the cost of a mining property as of March 1, 1913, or the value of a new discovery, but I have always refrained from doing so, because I could not find adequate figures of actual results. Even lacking these, it always seemed probable that sooner or later calculations based upon cost in 1913 would have to be abandoned, because that cost would be all accounted for. This has already happened in a good many properties, with the result that the owners find

themselves obliged to pay higher taxes than some competitors whose original "cost" or "value" was higher, or else seek the benefit of fresh "discoveries" under highly technical rules governing such discovery, or to manufacture through virtue of hindsight a higher "cost" or "value" for 1913. This bald statement of the case is enough to show that a sense of inequality more or less baffling and vexatious pervades the administration of the present law. It is of course doubtful if any tax law can be devised which will be entirely free from objections. There are, it seems, two suggestions: (1) to do away with the provision for depletion altogether, and (2) to make the provision arbitrary and permanent according to average, not individual, cases, so that the mining industry as a whole will pay the required aggregate of taxes. Under this arrangement, of course, some properties would pay more, others less, than at present. Naturally, those who would pay more would be aggrieved and those who would pay less would be gratified. It is hardly reasonable to expect that an agreement could be established upon a basis of *near-sighted* self-interest; it would rather be upon the perception that in the long run equity and fairness, with consequent stability, would be more valuable than a fleeting and insecure advantage to some and the disadvantage of others.

The figures presented by L. H. Parker, chief of staff, to the Joint Committee on Internal Revenue Taxation, seem to throw a strong and needed light on these points, such as could come only from the records of the Treasury Department. The "ratio of depletion allowed and net income from property" for the seven years 1922-28 inclusive was as follows, given in weighted averages for the period:

	Per Cent
Gold and Silver	37
Copper	60.5
Lead and Zinc	32.5
Iron	41.2
Coal	31.6
Sulphur	45.8
Arithmetical average of all	41.4

Off hand it would seem as if these figures prove the present system to be inequitable. Iron is almost exactly at the average, sulphur only slightly above it, and copper is far above it—that is, in the amount of depletion allowed. Coal may belong in a category by itself, because of the fact that the mining reserves can be figured more precisely than reserves for the other commodities. Lead and zinc and gold and silver have been allowed decidedly less than the average. Is not this exactly contrary to a reasonable expectation? These are precisely the metals in which the reserves are the scantiest, which most depend on continued discovery, and for which, consequently, the depletion allowance should be highest.

Moreover, on this showing it would seem as if the government would, for the present at least, actually gain by allowing the suggested flat depletion rate of one-third current income. Though it would lose the prospect of a diminishing allowance in the future through the exhaustion of original cost, it would gain through an immediate lowering of the allowances. Then there would most likely be a saving in administrative expense and in the cost of disputes and delays; all of which is so obvious as scarcely to need discussion.

After all, it is not clear that depletion should be anything more than the amortization of capital invested. Assuming that a mining investment is entitled to a return of 7 per cent on its capital, an allowance of a further 3½ per cent for amortization, this installment to have an earning power of 4 per cent annually, would restore the original capital in about twenty years. An allowance then of one-third current income would assume that the average mine was good for about that length of life.

It has never seemed to me that such an expectation was very much out of the way, although there are plenty of glaring exceptions in the direction of both shorter and longer life. In the case of very short-lived mines, say ones that will last only two or three years, an allowance of 33⅓ per cent out of annual return would seem to be low until we remember that the return must be exceptionally high anyway—say, 50 or 75 per cent a year—or else the operation will be unprofitable, tax or no tax; and the deduction would soon cover the investment. On the other hand, in cases where there is a prospect of life much longer than twenty years, it is worth notice that mining investments seldom remain unaltered for that length of time; there is usually a shifting to some new basis by sale or purchase, expansion, the adoption of new processes, or the building of new plants—all of which call for investments not originally foreseen. These new investments have the same right to be made good as the old ones, and in the course of time new and old become scrambled together so that it is about impossible to make an intelligible separation.

It seems to be arguable that the life of a mine is not really much longer than that of the plant which operates it; when the plant is renewed, either piecemeal or as a whole, the old mine no longer exists. It is hard to recall a case where this is not so. Take one of the oldest and best-known mines in this country, Calumet & Hecla: it is conducting business in the same locality, to some extent within the same buildings, even producing about the same amount of copper, but the operations have been profoundly changed in all sorts of ways; by consolidation with allied concerns through which the capital stock was changed from 100,000 shares to 2,000,000; by a new system of transportation, by development of new ores, and by installation of new plants for milling, smelting, and the reclamation of old tailings. How much money these changes represent I do not know, but it must come to a large fraction of, if it does not equal or surpass, the capital assets visible in 1911.

In other words, the value of a mine is less a matter of the ore in the ground and more of the plants and of effort to make that ore available than we have been accustomed to believe. This has long been recognized in the case of coal. I have several times been driven to conclude that coal in the ground is not worth anything: it assumes value only when somebody decides to mine it and commits himself to dependence upon a certain tract by creating a plant upon it and operating a business. Some other tract with just as much and just as good coal on it may lie a thousand years untouched, and nobody can tell which will be which.

Even metal mines of average merit are not normally valued at much more than the cost of equipment and working capital. In the case of copper mines, Mr. Arthur Notman estimates that such investments come to some 30c. per pound of annual capacity; that is, a mine like Calumet & Hecla, with an output of 120,000,000 lb. a year, would cost $36,000,000 to put in efficient running order, counting the lands and ore deposits a free gift of nature, costing nothing at all. The present market value of the company is not much more than half that figure.

One might argue from such a statement that mineral discoveries are not worth much and that therefore claims for depletion are not justified, but that is to miss the point. *Undeveloped* mineral lands are worthless. They become valuable only when development reaches a stage which renders commercial operation with a reasonable term of years a certainty, and their value depends wholly upon that operation. In turn, the operation can exist only while there is a supply of mineral such as will enable it to compete successfully with other operations; but if such an operation is left as originally established it will lose its competitive power, and in twenty years or so a change of base of some sort usually becomes necessary or advisable. The capital is depleted whether the ore is exhausted or not.

These considerations have a certain pertinence in relation to the "valuation" as of March 1, 1913. That date is back now approaching twenty years. Its bearing upon present-day competition in the mining business is wholly artificial. Were it not for the tax law nobody would ever think of it. To have to consider it, still more to pay out money because of it, is a vexation, and a constant temptation to hunt for some pretext to evade it. It seems reasonable to believe that depletion on a percentage basis, like that already adopted for the petroleum industry, and by the Dominion of Canada, would prove sounder and more equitable.

J. R. FINLAY.

Redlands, Calif.

OBITUARY

William J. Flewellyn, mine superintendent of the Dome mine, South Porcupine, Ont., died on Jan. 25, after a short illness.

Albert Z. Megede, organizer and president of the Delaware Mining Company, died early in February in a hospital in Denver, Colo.

Thomas Davis, past president of the Northwest branch of the A.I.M.E., and also of the Seattle Mining Club, died in Seattle on Jan. 27, at the age of 76 years.

Carl K. Dresser, president of the Dresser Mining Company, died at Johns Hopkins Hospital, in Baltimore, Md., on Feb. 1, after a short illness. He was 40 years old.

■

An Appreciation

F. H. Mason, correspondent for *Engineering and Mining Journal* in British Columbia for many years, died suddenly on Feb. 7, after a brief illness. The immediate cause of his death was a cerebral hemorrhage. As a writer of mining articles, Mr. Mason was accurate and capable, and he performed a real service for our mining industry in sending reliable information on mining. I feel a distinct personal loss in his passing, as his cheerful disposition in spite of physical infirmity, endeared him to all of us.

JOHN D. GALLOWAY,
Provincial Mineralogist.

Bureau of Mines, Victoria, B. C.

Digest of Current Technical Literature

Selected from abstracts of articles in the leading technical periodicals, prepared by Engineering Index Service, American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

Asbestos Deposits: South Africa:—"The Asbestos Deposits of South Africa." R. Stappenbeck. *Zeit. fuer praktische Geologie (Halle)*, Vol. 38, No. 10, Oct. 1930.

CLASSIFICATION of asbestos ores and their occurrence in South Africa; origin and geology of deposits; engineering and economic aspects of mining. Bibliography.—E.I.S. New York.

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Silver Ore Treatment: Cyanide — "Rincon Cyanide Plant of Lane Rincon Mines, Inc., in Temaxcaltepec, Mex." *Boletin Minero*, Vol. 29, No. 2, Feb., 1930.

GENERAL data; ways and means of transportation; ore characteristics; cyanide process; equipment; practice.—E.I.S. New York.

•

Copper Ore Treatment—"A New Concentrator at Rio Tinto." R. O. Stokes. *Min. Mag.*, Vol. 43, No. 6, Dec., 1930.

DESCRIPTION of plant for concentration of cupriferous sulphides which has been designed by General Engineering Company. —E.I.S. New York.

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Clay Mines and Mining: Excavators—"Small Excavators in Clay Industry." I. Winkel. *Tonindustrie-Zeitung*, Vol. 54, No. 97, Dec. 4, 1930.

DEEP excavator described, similar to chain-bucket excavator, but instead of eight to ten buckets attached to chain on right and left sides, only one bucket, or in the case of larger machines, two buckets, required.—E.I.S. New York.

•

Pyrite Treatment—"Treatment of Meggen Iron Pyrites and Barite." Gletzel. *Metall und Erz*, Vol. 28, No. 1, Jan. 1, 1931.

EXPERIMENTAL flotation plant; data on flotation, aggregates, operating costs, supervision, utilization; initial costs of all treatment plants; use of product.—E.I.S. New York.

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Mineral Resources: Germany—"Mineral Resources in Germany." Krenkel. *Internationale Bergwirtschaft und Bergtechnik*, Vol. 23, No. 24, Dec. 30, 1930.

LOCATION and exploitation of barite deposits; mining methods; extent of use of barite; production in 1925, 270,000 tons; tabulation of production from 1880 to 1925 in Germany and other countries.—E.I.S. New York.

•

Electric Locomotives: Mine — "Eighty-five-Ton Electric Locomotive for Fu-Shun Colliery." N. Gengo. *Shibaura Rev. (Tokyo)*, No. 6, Dec., 1930.

PERFORMANCE, dimensions, arrangement of apparatus, descriptions of truck, controlling equipment, main motors. (In Japanese.)—E.I.S. New York.

•

Ore Minerals: Microscopic Analysis—"Microscopic Investigation of Molybdenite Ore From Climax, Colorado." L. W. Staples and C. W. Cook. *Am. Mineralogist*, Vol. 16, No. 1, Jan., 1931.

MOLYBDENUM minerals are of common occurence, but few deposits are of economic value; that at Climax, Colo., is largest known; paper is not detailed description of many sections studied, but is record of those observations which may possibly have bearing on question of origin of deposit.—E.I.S. New York.

•

Copper Industry — "Development of World Copper Economics in Relation to Progress in Mining and Metallurgy." E. Hentze. *Metall und Erz*, Vol. 28, No. 1, Jan. 1, 1931.

MINING and metallurgical production and world consumption have increased about 100 per cent since 1920; technical progress in mining, ore treatment, and refining has resulted in bringing production more and more into the hands of a few large-scale producers, so that price of copper today is relatively not higher than before the war. —E.I.S. New York.

•

Ore Handling: Unloaders—"Huge Ore Unloaders at Toledo Pick Up Seventeen Tons of Ore at a Bite." *Port and Terminal*, Vol. 10, No. 11, Dec., 1930.

FEATURES of electrically driven unloaders recently erected on Chesapeake & Ohio Railroad docks, Hocking Valley Division, at Presque Isle, Toledo; eight motors, totaling 1,060 hp. on each unloader; transformer stations three-phase 60-cycle, 6,600 volts incoming, 440 volts outgoing.—E.I.S. New York.

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Mine Shafts: Maintenance and Repair—"Notes on the Collapse and Recovery of the Randfontein Deep North Shaft, Now Called No. 2 North Shaft." H. J. Hebbard and W. H. Mitchell. *S. African Instn. Engrs.—Jl. (Johannesburg)*, Vol. 29, No. 4, Nov. 1930.

SEVEN-compartment shaft, 42x8 ft., sunk 2,083 ft.; wall of shaft caved, forming crater but leaving concrete collar in place; inclined exploration winze was sunk; shaft timbering was reconstructed and built up from 300 ft. depth, and surrounded with concrete; crater filled with weak concrete. —E.I.S. New York.

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Silver Ore Treatment: Mexico — "New Operating Program of Cia Real del Monte y Pachuca." A. Noble. *Boletin Minero*, Vol. 29, No. 2, Feb., 1930.

SUBSIDIARY of U. S. Smelting, Refining & Mining, operates silver mines in Pachuca, Real del Monte, and El Chico districts; 3,500 tons of ore treated per day; new program involves shutting down Guerrero mill and centralizing at Loreto plant; outline of revised flow sheet.—E.I.S. New York.

•

Mine Ventilation — "Ventilation and Dust in Metal Mining." A. J. Moore. *Chem. Eng. and Min. Rev.*, Vol. 23, No. 266, Nov., 1930.

VENTILATION and dust are most important factors in mine hygiene; mortality from siliceous dust in metal mining is greater than from accidents of all kinds; first requisite of any worker is adequate supply of air of high degree of purity; temperature; humidity; contaminations; quantity of air; compressed air; shot firing; danger of quartz dust; measurement of dust. Bibliography.—E.I.S. New York.

Excavating Machinery: Dragline — "Continental Cable Scraper Conveyors for Disposing of Spoil." *Mech. Handling*, Vol. 18, No. 1, Jan., 1931.

APPLICATIONS of drag or cable conveyors are described as used for formation of coal and mineral stores and for disposal of spoil. —E.I.S. New York.

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Lead Ore Treatment: Flotation—"Wetting Phenomena With Blende and Lead Glance." E. Berl and B. Schmitt. *Kolloid Zeit.*, Vol. 52, No. 3, Sept., 1930.

WETTING of materials such as blende and lead glance by liquids is determined largely by presence of surface films of oxidation products; efforts of alkali hydroxides, cyanides, and xanthates on wet ability of blende and lead glance were investigated.—E.I.S. New York.

•

Mine Cars — "Better and Bigger Cars Needed in Modern Mines." G. A. Richardson. *Coal Age*, Vol. 35, No. 11, Nov., 1930.

OWING to radical changes in coal-mining methods, old mine-car designs are becoming obsolete; types are wood, composite, and all-steel car; replacement of swinging door by lifting endgate; tight end composite car; types for rotary dump; difficult to obtain suitable lumber for car bottoms; examples of all-steel cars; betterment is needed in type of wheels used on cars; mine transportation methods are passing through same cycle of development as have steam railroads.—E.I.S. New York.

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Ore Treatment: Classification — "Application of After Classification Process to Flotation Wastes for Improvement of Ore-Treatment Yield." H. Boerner. *Metall und Erz*, Vol. 27, No. 24, Dec. 2, 1930.

INVESTIGATION of metal distribution in flotation wastes with aid of screen analyses; practical results and economic aspects of subsequent classification.—E.I.S. New York.

•

Copper Smelting Plants: Sweden—"Copper Smelting Plant at Rönnskär." A. Lindblad. *Teknisk Tidskrift*, Vol. 60, No. 46, Nov. 15, 1930.

SMELTING and refining plant in Sweden refines ore from deposits at Boliden; ore is very rich and of extraordinary composition. Four roasting furnaces have combined capacity of 250 tons ore per day, and eight additional furnaces under construction will have combined capacity of 800 tons per day; process illustrated by flow diagram. —E.I.S. New York.

•

Geophysical Exploration—"Geophysical Exploration of the Subsoil." N. Gella and J. Brueggen. *Boletin Minera de la Sociedad Nacional de Mineria*, Vol. 42, No. 377 and 378, Sept. and Oct., 1930.

RELATION between geological study and geophysics, with special reference to possible applications in Chile; metalliferous deposits; coal; petroleum; underground water; civil engineering projects; gravimetric, seismic, and magnetic methods. Radioactive, geothermic, and electric methods; examples of use of electric method. Bibliography.—E.I.S. New York.

INDUSTRIAL PROGRESS

Calumet & Arizona's Steam Power Plant Establishes a Standard

George J. Young
Associate Editor

Cooling tower

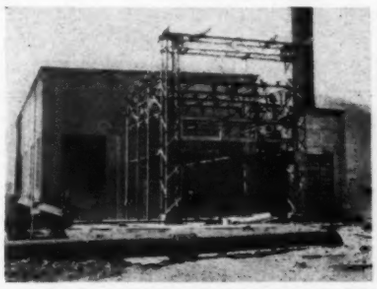
DURING the past two years the large copper mining companies in Arizona have made substantial improvements in operating facilities and in some cases have increased potential capacities by increasing the size of units or increasing the efficiency of equipment. Power-generation equipment has been modernized, and in some instances the plant has been made self-contained with respect to power requirements. The latest power plant for mine requirements was installed at Lowell, Ariz., by the Calumet & Arizona company. This unit establishes a standard.

Oil is used as fuel. Two 725-hp. Walsh & Weidner boilers of the cross-drum type supply steam at 400 lb. and 200 deg. superheat. Maximum rating is 250 per cent. They are served by a self-supporting steel stack 9 ft. in diameter by 150 ft. high. Buffalo Forge blowers, two motor-driven (20-hp. motors, each 20,000 cu.ft. per minute) and one steam-turbine-driven (36,000 cu.ft. per minute), supply air to the wind boxes. Each motor-driven blower is large enough for a single boiler, the turbine blower being sufficient to serve both boilers.

A Pratt-Daniel booster fan with Venturi outlet in stack, and driven by a 40-hp. motor, is used for high ratings. Mechanical oil burners are of the Morse Drydock company's type, set to operate as high as 250 per cent of rating. Each boiler is served by five burners. Duplicate duplex oil pumps of the Dean Hill type supply oil to the burners. Duplicate sets of plunger feed pumps of the same make are used for low rating, and a Dean Hill centrifugal feed pump driven by a Westinghouse steam turbine is used for high rating. Oil heaters are used on the fuel pumps, and feed-water heaters of the Cochrane de-aërating type on the boiler feed water supply. Cochrane hot-process water softener and de-aërating heater deliver the feed water to an E. Hensey continuous blowdown, then to the boilers, which are equipped with Diamond soot blowers, Copes feed-water regulators, Reliance water columns, Tagliabue thermometers, Hagan combustion controls, and Bailey steam-flow meters.

Steam is taken through an 8-in. header to the steam receiver and by 6-in. branches, one of which supplies the turbine and the other reducing Mercon valves and desuperheater, which reduce pressure to 175 lb. and superheat to 45 deg. and deliver to an 8-in. pipe line supplying the steam hoist at the Junction shaft.

The single unit is a 3,750-kva., 3,600-r.p.m. Westinghouse generator, direct-driven by a steam turbine. Voltage is 2,400 and ampereage, 904, at a power factor of 95 per cent. Cooling air for the generator circulates in a closed system, and its heat is extracted by a U-fin air cooler. Exhaust steam is received in an Elliot surface condenser. A centrifugal circulating pump operated by a 100-hp. motor supplies 6,000 g.p.m. cooling water to the Foster-Wheeler cooling tower, which is installed alongside of the power plant. The cooling towers, constructed of Oregon fir and redwood are of both forced and natural draft types. Forced draft is generated by airplane propellers, which are 11 ft. in diameter and are driven by 20-hp. electric motors.



General view of Calumet & Arizona's new power house

Steam pipe coverings were supplied by Johns-Manville, high-pressure valves by Lunkenheimer, medium and standard valves and steel pipe and fittings by Crane. Eight Bailey flow meters are included in the equipment, one on the condensate, one on the makeup, one on total feed water, two on boilers for total steam, one on the turbine, and one on the steam line to the hoist. A Bailey temperature recorder is on the fuel oil heater. Two 6,900-gal. fuel oil tanks supply the day's requirement. These receive their supply from the main fuel tank.

A Westinghouse metal-panel switchboard, of fourteen panels, takes care of three main breakers, one from the turbine-generator and one from each bank of transformers on the incoming power line from Douglas, and fifteen outgoing circuits. Single-bus disconnect switches are used, so that any breaker can be isolated. In the same bay with the turbine are two duplex Sullivan air compressors, 4,400 cu.ft., Type WN4, each driven by a 2,200-volt, 700-hp. Westinghouse synchronous motor at 225 r.p.m. Provision has been made for a third compressor unit, which is to be moved from its present position near the Junction shaft. A separate switchboard is provided for the compressor motors. In addition, a 150-kw. motor-generator set provides direct current for surface and underground motor haulage. A 10-ton traveling crane serves the bay in which turbine, compressors, and condenser system are placed.

The power building is of steel-frame construction with 8-in. hollow-tile walls plastered inside and outside. Its roof is of steel decking covered with 1-in. insulation and with a twenty-year bonded Johns-Manville roofing. Steel sash is used throughout. Floors are of cement, protected by a floor paint. White paint is used upon the inner walls. The boiler room is 50x80 ft. by 43 ft. in height and the dimensions of the turbine room are 50x120 ft. by 36 ft. in height.

Foundations required 2,000 cu.yd. of concrete. Steel erection started Jan. 1, 1930, and the plant was practically finished by May 15, 1930. W. W. Jourdin, of New York, designed it and Paul Nelson superintended erection and installation. The important units supplied are the steam hoist at the Junction shaft, an electric hoist at the same shaft, two electric hoists at the Campbell shaft, the underground pumping station on the 2,200 level, and the compressor and shop motors. Supplementary power is received from the power stations situated at the Douglas smelters.

Hard-Facing With Stellite Prolongs Life of Mining Tools

Fig. 1—Auger drills that have been stellited on tip

MINING equipment must be able to withstand hard usage, and at the same time resist abrasive wear. A hard steel is not sufficiently ductile, and a tough steel is not hard enough to resist abrasion. Application of a hard-facing material fills this demand perfectly. When applied to the edge or parts of machinery receiving the greatest wear, it furnishes a surface extremely resistant to abrasion, and the steel base metal properly supports the wearing surface and retains the strong, tough qualities so necessary to prevent breakage.

The uses of hard-facing alloys are many and varied, ranging from a few drops of the material on the tip of an auger drill to a complete coating on a 900-lb. tooth for a 12½-yd. shovel. Between these two extremes lie innumerable applications. Fig. 1 shows two auger drills used in a Michigan mine.

Stellite has been applied to the tip of the bit as shown. A thin layer is all that is required, but it lengthens the life of the bit many times over when the drill is used in moderately soft formations. For use in soft rock such as gypsum, jackhammer drills have been hard-faced successfully, with a resulting increased footage per drill nine times that of the ordinary bit. Churn-drill bits treated on the cutting edge and reaming edge with wear-resisting material give three to six times the footage of tempered bits before dressing becomes necessary.

Underground scrapers, treated on the teeth and edges receiving the greatest wear, last 3½ times as long as the ordinary steel scraper, and can be reconditioned many times by building up the worn edges. When the chrome-molybdenum-steel teeth on electric car loaders are hard-faced, their life is many times that of the untreated teeth. The manganese-steel keys for underground car couplers are hard-faced as standard practice in many mines. Hand shovels, treated at a cost of approximately 9c. each, last at least twice as long as the ordinary shovel. A ⅛-in. layer of abrasion-resisting alloy increases the life of clamshell buckets from one to five months over that of the usual manganese steel ones.

Fig. 2—Dipper teeth, showing location of hard facing

Fig. 2 shows two dipper teeth hard-faced for a distance of 6 in. back from the end of the tooth on both faces. The coating was $\frac{5}{16}$ in. to ⅜ in. deep. The teeth were preheated in a muffle furnace, although a brick-up furnace could have been used. Six 900-lb. chrome-molybdenum steel teeth used in the dipper of a 12½-yd. electric shovel were faced with a wear-resisting alloy. After removing 400,000 cu.yd. of dirt and limestone, thus lasting nine times as long as the original teeth, they were still sufficiently good to be rebuilt.

Stellite's ability to resist abrasion gives it a wear ratio of three to five times that of ordinary steel. The alloy has considerably more red hardness than any other hard-facing material, retaining its hardness at practically a red heat.

Similar to stellite in its application is the so-called Hascrome welding rod, also made by Haynes Stellite Company, New York. Recent tests by a mining company in northern California have shown its application to worn crusher mantles to be highly successful. The average life of a manganese steel mantle crushing copper pyrites was found to be approximately six months. At the end of this time the 2½ in. metal is practically worn through. One of these castings was reclaimed after being taken out of service by building up the worn surface with Hascrome. Ninety pounds of this material was used, requiring 25 hours of labor to apply it. The total cost of rebuilding, including overhead, amounted to slightly more than 25 per cent of the cost of a new mantle. At the end of four months, this part, having crushed 28,000 tons of copper pyrites, showed but $\frac{3}{32}$ in. of wear. It was again recoated and put back into service.

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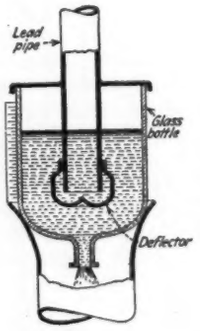
Measuring Volume and Flow of Liquids

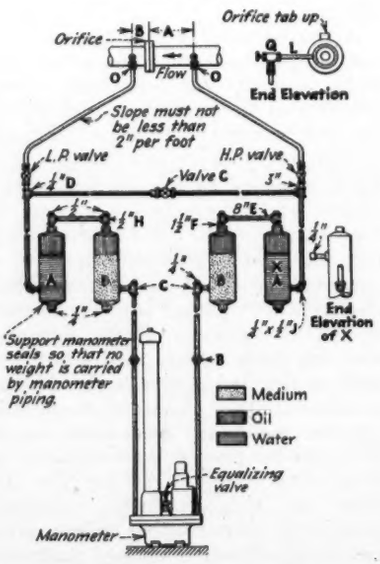


A glass bottle from which the bottom has been removed makes an effective flow meter for corrosive liquids

IN ELECTROLYTIC ZINC and cadmium production, and in similar work, the volume of solution used in continuous systems is regulated by determining the acid concentration and by measuring the solution level in tanks of known capacity. Such simple means seem sufficient for the purpose in many cases. Under certain conditions, however, the use of a flow meter may be found convenient.

An electric flow meter, shown in the accompanying cut, is made by the Brown Instrument Company, Philadelphia. It operates on the inductance bridge principle, and is inherently independent of voltage changes. It has an automatic planimeter which records volume units of flow on the chart rim, so that the amount of flow for any period can be read. The meter is equipped with a forged-steel manometer, which is safe for high pressures and sufficient for six ranges. Ranges may be changed easily and quickly. The standard high-pressure manometer is tested to 1,500 lb. and special models to 2,500 lb. A third model is available for unusually high pressures. The manufacturers state that this meter may be used for measuring the flow of any liquid, whether corrosive or not. This

New electric flow meter



is possible through the use of the proper seal, whereby a corrosive liquid is prevented from coming in contact with the parts of the instrument that might otherwise be injured.

When necessary to control the rate of flow of acid or other corrosive liquid within fairly narrow limits, the simple flow meter and indicator shown in the accompanying sketch will often prove satisfactory—this according to *Chemical and Metallurgical Engineering*. As built for the control of sulphuric acid flow in an Illinois plant, the meter consisted of an ordinary 1-gal. glass bottle from which the bottom was cut by the familiar method of wrapping with a kerosene-soaked string, burning the string, and dipping the bottle into cold water. A lead cover burned to the lead in this pipe and a lead baffle or flow deflector completes the apparatus. Although a rough calibration may be made by using the hydraulic flow formula, it is necessary to calibrate head against discharge rate by actual measurement, where any degree of accuracy is desired.

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Makes Weighing Automatic —Other Devices

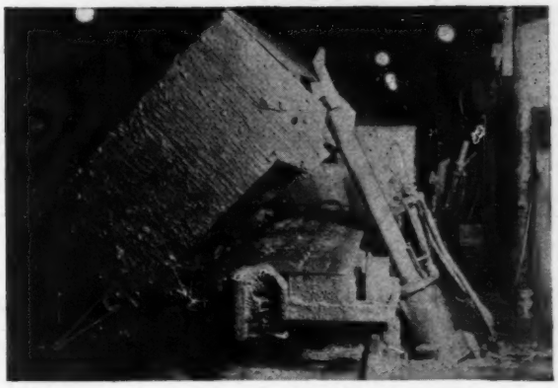
Mine warehouses having a Howe scale will be interested in the company's new so-called "Weightograph," a device that may be attached to any beam from the small warehouse type up to the large railroad track scale, thereby making an automatic scale out of it. The operating principle is based upon optical magnification, instead of the other form of automatic weight indication which is based upon mechanical multiplication. The instrument is also made in a self-contained type, in which the platform lever system and indicating mechanism are a unit.

Controlling Station Auxiliaries

Standardization of a new line of metal-clad switchgear for controlling station auxiliaries has been effected by the Delta-Star Electric Company, Chicago, Ill. This switchgear incorporates a high-speed oil circuit breaker with control switches, relays, meters, and indicators for control of three-phase motor circuits. It is completely inclosed to prevent entrance of dirt, water, and vermin.

Two-Way-Dump Mine Car

An illustration shows a new two-way-dump mine car with automatically down-folding doors, recently developed by the Differential Steel Car Company, Findlay, Ohio. This car combines low height and stability and gives no chance for accidental dumping. It is of all-steel construction, simply built and operated, being without locking mechanism. A very simple dumping device (a single-stroke, single-acting air cylinder) is required, as shown, the body returning by gravity to its normal running position in which it is supported on widely spaced trunnions. The car shown is of 50-cu.ft. level-load capacity.



Two-way side-dumping mine car requires use of simple device, as shown, for dumping

Drip Covers for Motors

To protect motors in bad locations from dripping water, acid, or other injurious solutions, the Reliance Electric & Engineering Company, Cleveland, Ohio, has developed drip covers applicable to either the a.c. or d.c. motors that the company makes. The covers are made of heavy-gage steel bolted to the frames in roof-like fashion so that an opening is provided between motors and cover to permit free circulation.

A Herringbone Rotor

Engineers of the Sterling Electric Motors, Inc., Los Angeles, Calif., have developed a rotor of herringbone design that is said to provide noiseless operation, to eliminate end thrust and resulting wear on bearings, friction losses, and lateral pounding, to improve pull-out efficiency and power factor, and to reduce exciting current, heating, and eddy current losses, as well as the so-called iron losses.

BULLETINS

Coal Pulverizer—Fuller Lehigh Company, Fullerton, Pa. Bulletin No. 80, new Type B pulverizer.

Steam Generating—Combustion Engineering Corporation, 200 Madison Ave., N. Y. Catalog No. G.C.-6, fuel-burning and steam-generating equipment.

Steam Turbines—DeLaval Steam Turbine Company, Trenton, N. J. Souvenir booklet entitled "A Pioneer in High-Pressure Steam."

Sampler—Galigher Company, 228-32 South West Temple St., Salt Lake City, Utah. Geary-Jennings sampler.

Power Transmission—Link-Belt Company, Philadelphia, Pa. Book No. 1274, P. I. V. gear.

V-Belt Drives—Worthington Pump & Machinery Corporation, Harrison, N. J. Bulletin No. L-400-B1, Multi-V-drive for power transmission.

Wire Rope Tramways—Riblet Tramway Company, Spokane, Wash. Riblet aërial tramways.

Portable Lighting Plants—Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill. Bulletin No. 100-B, portable electric plants.

Pumps—Worthington Pump & Machinery Corporation, Harrison, N. J. Bulletins No. D-423-B1 and D-450-B1A, vertical triplex pumps and deep-well pumps respectively.

Rock Drills — Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill. Bulletin No. 87-C, Type "1-8" rotators.

Grinding Mills—Williamson Company, 582 Market St., San Francisco, Calif Bulletin No. 30.

Gears—W. A. Jones Foundry & Machine Company, 4401 Roosevelt Road, Chicago. Catalog No. 48, herringbone cut gears.

Compressors — Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill. Bulletin No. 83-T, vertical direct-motor-driven.

Compressors — Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill. Bulletin No. 83-Z, vertical, high-presssure.

Mine, Quarry, Gravel Pit Machinery—Smith Engineering Works, Capitol Drive at Holton St., Milwaukee, Wis. Bulletin No. 266G.

Air Compressors—Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill. Katalog Nr. 183-G. Luft- und Gas- Kompressoren und Vacuumpumpen.

Centrifugal Pumps — Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Bulletin No. 1647. Type "SSU" centrifugal pumping units.

Rock Drills — Sullivan Machinery Company. 400 North Michigan Ave., Chicago, Ill. Bulletin No. 87-E, self-rotating water stoper, class "S-2."

Power Shovels—Bucyrus-Erie Company, South Milwaukee, Wis. Bulletins No. D-1006 and FBE-10901, electric-steam revolving shovel and dragline shovel crane, respectively.

Gas Holders—Stacey Brothers Gas Construction Company, 5535 Vine St., Cincinnati, Ohio. Bulletin No. 32, covering "Bullets" for holding high-pressure gas; also other holders.

General Catalog No. 4000—Traylor Engineering & Manufacturing Company, Allentown, Pa. Mine equipment.

NEWS OF THE INDUSTRY

A.I.M.E. Meeting Attracts Good Attendance

Business Depression Fails to Lessen Number Greatly or to Dampen Spirits at Annual New York Gathering—Tally Is New Head—Technical Papers Arouse Discussion

ANY real or fancied depression that the mining industries of the country may be suffering was not in evidence when one viewed the large and prosperous looking throng that crowded the Engineering Societies Building in New York last week, from Feb. 16 to 19 inclusive, on the occasion of the 140th annual meeting of the American Institute of Mining and Metallurgical Engineers. Though the total registration fell about 400 below the 1,700 total of a year ago, the absenteees were not conspicuous. And most of those present appeared to be in good humor, and with a wealth of interesting information on tap as to the accomplishments of themselves and their associates during the last year.

A full four-day program of technical sessions, arranged for group interest, left little excuse for any member to find time hanging heavy on his hands during the day. Practically all of these meetings were well attended and aroused as much discussion as could be allowed in the time allotted. The outstanding social event, of course, was the president's reception and formal dinner-dance at the Commodore on Wednesday night. Second in importance were the informal dance at the Grand Central Art Gallery the night before, and the smoker, for men only, on Monday night. An innovation was tried this year in having the smoker preceded by a dinner, the combined event taking place in the large ballroom of the Pennsylvania Hotel. Several good acts of vaudeville after dinner occupied every one's attention.

Many other diversions were offered to both the men and women attending the meeting, including television demonstations, skyscraper visits, committee and alumni dinners, a dance recital, sightseeing, and a theater party. The Woman's Auxiliary deserves special mention for its part in the entertainment of the visitors.

The new officers of the A.I.M.E. follow: President, Robert E. Tally; vice-presidents, Howard N. Eavenson and H. A. Guess; directors, Louis S. Cates, Karl Eilers, S. R. Elliott, H. G. Moulton, and William Wraith. All were elected with no more than one or two votes in opposition, about one-quarter of the membership returning the ballots marked for the names selected by the committee on nominations.

Nothing sensational developed at the annual business meeting held on Tuesday morning, which attracted about 100 members. Membership gained slightly during the year and a surplus of about $1,000 of receipts over expenditures was shown, which was generally considered an excellent record in a year of industrial depression.

Geophysics Sessions

Much interest was shown in the program of the two sessions on geophysical prospecting, of which Allen H. Rogers and D. H. McLaughlin were the respective chairmen. A "laboratory" demonstration of the use of "Megger" was given by Sherwin F. Kelly, Bela Low, and W. B. Creagmile, with Professor McLaughlin as referee. Work with the Hotchkiss "Superdip" was discussed by Noel H. Stearn. Still another instrument, the "Racom," developed by Theodor Zuschlag, was discussed by Mr. Zuschlag and Hans Lundberg. It is a sensitive bridge arrangement for determining potential drop ratios rapidly and accurately.

Papers presented were freely discussed. The mathematical solution presented by Ehrenburg and Watson for calculating the flow and distribution of electricity in stratified media was criticised by Irwin Roman, who challenged its validity, particularly the authors' statement that their solution, as they gave it, was simple and complete. Dr. C. A. Heiland took a prominent part, abstracting some papers and discussing most of them. He aroused particular interest when he told of making magnetometric observations from an airplane.

Professor Fisher, of the Michigan College of Mining and Technology, described various geophysical researches conducted by the school. He spoke of the use of electric and magnetic methods and aerial mapping for filling in gaps in work done on faults. The aerial map showed the Keweenawan fault remarkably, he said. The dip needle was fastest for locating faults. Work was also being done to determine earth-temperature gradients, he said. Gravimetric surveys were under way to determine the average earth density.

Milling Methods

A crowded room demonstrated the interest of the members and guests in milling, the session on that subject being held on Monday afternoon. Most of the papers had to do with flotation and with experimental studies of ball-mill performance.

E. M. Hamilton submitted written discussion of H. S. Gieser's paper on the flotation of oxidized silver ores, pointing out that two classes of refractory silver ore were found in Mexico, one containing manganese and the other a bright red ore for which the only known method of treatment was based on a preliminary chloridizing roast. The manganese ore could be treated in one of three ways: with sulphurous acid to dissolve the manganese; with a chloridizing roast; or with a reducing roast, employing producer gas, for example. In general, the silver ore difficult to float was also difficult to treat by cyanidation.

A. W. Fahrenwald presented his two papers on experimental work with small ball mills at some length. Written discussion was offered by John Gross and E. W. Davis, which brought up the question as to whether results with a mill of 1 or 2 ft. diameter were applicable to an 8-ft. mill. S. Power Warren stirred his hearers to the first real applause of the afternoon by a plea for more practical assistance to the ball-mill operator, and less evasion of responsibility for poor operating conditions. He cited some startling conditions where a circulating load of 5,000 per cent of the ball-mill feed obtained, and where a classifier was returning twice as much fully ground feed to the ball mill as the mill was taking of original feed. The character of the electrolyte was of decided importance, in Mr. Warren's opinion, in affecting conditions in classifiers and ball mills. Will H. Coghill contributed to the afternoon's discussion. Among other things, he made a plea for reporting solids in a pulp in terms of volume rather than of weight. Moving pictures of ball-mill experiments by Haultain and Dyer at the University of Toronto closed the session.

Engineering Education

Both the committee luncheon and the regular session on engineering education were marked by an enthusiastic interest on the part of a large attendance. At the luncheon Dr. A. D. Flinn, director of Engineering Foundation, outlined the plans and progress of that organization with its educational program, particularly in dealing with the student in the secondary school. The subject of "interest vs. aptitude" (two quite different characteristics of prospective engineering students) prompted the deans of two of the leading mining schools of the country to confess, in the course of a general discussion that occupied most of the luncheon period, that they each had had a decided interest in learning to play a musical instrument—one a cello and the other a violin—but the aptitude in each instance had been nil.

Dr. H. P. Williston, of the American Council on Education, pointed out in the discussion of the regular session that only 28 per cent of those entering institutions of higher learning in this country are graduated. The field for which students are to be trained should be defined, he said, in terms of action. Students should then be selected and courses of education built to meet these terms imposed by the work to be performed. Knowledge of facts is not nearly so important as other personal qualities of the student, in so far as his future endeavors are concerned.

Mining Methods

The Monday session on mining methods resolved itself largely into a general discussion of the proper method of handling misfires, with Scott Turner presiding. Absence of the authors prevented more than a superficial consideration of the three papers that were presented.

Much favorable comment was occasioned by the four papers on mining methods that were presented at the Wednesday session by members of the U. S. Bureau of Mines. T. T. Read stated that the recent publications by the Bureau on the subject have made possible for the first time the scientific teaching of mining methods. W. S. Hutchinson remarked that, inasmuch as each technical term that appeared in the numerous publications was used with but a single meaning, the publications would be influential in building up a generally recognized usage of words—a condition that does not prevail at present, as is evident in the use of the words *dirt* and *rock* in some districts to connote *ore*.

Ground Movement and Subsidence

The first two hours of the session on ground movement and subsidence was a lively post mortem of the well-known Marquette Cement vs. Oglesby Coal suit, with several of the participants in that suit present and contributing largely to the discussion. H. I. Smith suggested that the voluminous data that had been prepared at the time of the suit be assembled either for publication or so that it may be readily consulted.

What was hailed as an outstanding contribution to the study of mining

R. E. TALLY

problems was made by P. B. Bucky, who described his method of testing mine models in a centrifuge. The method depends on the principle that if the density of the model is increased directly in proportion to its decrease in size as compared with the original, then the model will behave in a manner identical with the original. The method is said to be the only important new application of the principle of dynamical similarity that has been devised in recent years.

Gold Symposium

A large attendance at the Gold Supply symposium, on Tuesday afternoon, indicated the general interest in this topic. Conflicting views were presented, and the listener came away with the impression that increased gold production both is and is not necessary for financial stability and that increased supplies both are and are not available. From a technical viewpoint, perhaps the most significant statement made was that by Dr. L. C. Graton, of Harvard, who declared that the miner has lagged behind the millman in cost achievement, and that a possibility existed for substantial reduction of underground costs.

In the discussion that followed the prepared addresses, optimism was the prevailing spirit. Julian Boyd, of Los Angeles, declared that both Southern Rhodesia and Australia still held promise as prospective gold producers, despite recent declines in output. The Australian gold bonus would, of course, result in treatment of lower-grade ores, he declared, but an even more important factor in increasing the country's output was the improvement in grade noted at depth on some of the Kalgoorlie mines, notably Lake View & Star. He believes the Kalgoorlie orebodies may eventually be mined to a depth of 8,000 ft.

Robert Hoffman added that geologists do not know much about gold and that the comparatively infinitesimal amount of gold in ore, from a volume standpoint, was a factor that had to be taken into account. Surface exploration was frequently inconclusive, he declared. The persistence of a few men had been the factor responsible for some of the major discoveries, notably in Canada.

D. H. McLaughlin, of Harvard, discussed costs and grade at the Homestake, where, he said, no evidence of "zoning" has been found with increasing depth. A. C. Daman, of the Denver Equipment Company, seizing upon the confession by some of the speakers that the gold supply might not be sufficient to supply currency needs, urged adoption of a 16:1 ratio for silver and the coining of bi-metal currency containing silver and gold in equal value. Harrington Emerson also took up the cudgels for silver.

Non-Ferrous Metallurgy

Many interesting facts were presented in the discussion following the presentation of the various papers on non-ferrous metallurgy. In commenting upon G. L. Spencer, Jr.'s, paper on high-silica retorts, A. L. J. Queneau stated that these retorts have been a decided improvement in the practice of zinc distillation on account of their greater strength and ability to keep straight under a heavy load. The new feature in the development was the crushing of the quartz through 140 mesh. Use of quartz, however, was not new, as substitution of quartz for part of the grog had been standard practice in Europe for many years. The type and origin of the quartz used was, however, of minor importance. Reports from other plants where the retort had been introduced confirmed these statements. Only at one plant, where the hydraulic press was not used for making the retorts, did their life not exceed that of the old type of retorts. The importance of tests to study the relative density figures of the different retorts was pointed out.

C. E. Swartz's paper on failure of cast-iron kettles in lead refining was followed by a lively discussion, and many divergencies in the results obtained at the various plants were disclosed, indicating the complexity of the question. Much could be accomplished by proper firing to reduce local over-heating. Improvements had been made in later years in setting the kettles and in the construction of the fireboxes. Some operators have discontinued the practice of resetting the kettles, as the process involves new strains, often more serious than those resulting from overheating.

Conference on Iron Ore

Iron-ore men got together on Tuesday afternoon to discuss problems common to producers and consumers of ore. As a basis for discussion, C. D. Williams summarized current practice of beneficiating iron ores. The chairman then said that to inquire into the advantages of the three methods of agglomerating—namely, nodulizing, sintering, and briquetting—would be of interest. P. G. Harrison, speaking informally, described sintering at the Evergreen Mining Company's plant, on the Cuyuna range. W. Rowland Cox, referring to work at Moose Mountain, Canada, some years ago, said that he preferred a briquette to a sinter, this because Mr. Williams had said that briquetting had failed. Briquetting could have been done at Moose Mountain for $1 per ton, Mr. Cox thought. Discussion bringing up the question of the function of water in sintering, H. J. Stehli, of the Dwight & Lloyd Sintering Company, said that water serves to loosen up the charge and make air passages. Mr. Harrison had said that it was impossible to ignite the charge, unless water were first added, no matter what the original per cent of moisture in the ore. T. B. Counselman, of the Dorr Company, discussing ore-washing practice, pointed out that one cannot afford to do things to an iron ore that can be done with copper ore, for instance, because of the widely differing values of the product.

Mining Geology

Lively discussion featured the session on mining geology Wednesday morning. Dr. Waldemar Lindgren, following the presentation of a paper on zonal relations of lodes in the Sumpter Quadrangle, suggested that anyone who names rocks should say why, at least in a footnote; also that those who use the term "veindike" should define it. Sidney Power's paper on "Occurrence of Petroleum in North America" represented a concentration of a remarkable amount of information in small bulk, the chairman said, and should interest even those not directly concerned with oil. Donald C. Barton, discussing the paper, said that the geophysicists in the Gulf Region had had the task at first of finding the shallow domes and had done it with 200 per cent efficiency, whereupon Professor Graton remarked that he now knew where the geophysicists stood, that they claimed to find twice as many things as there really are. W. H. Newhouse's paper on relations of ore deposits to anticlines and synclines was commended by Dr. Lindgren. It had involved a time-consuming study of the literature of ore deposits. Ira Joralemon, however, said that it raised the question of whether the greater number of deposits are found on anticlines or simply occur on anticlines. Prof. Alan M. Bateman deplored generalizing too quickly and hoped that emphasis would not be put on anticlines when in many cases simply tilted strata were meant. Prof. D. H. McLaughlin said that when one summarized literature one was likely to run into the mistakes of others. D. F. Hewett said that it was easy to be complimentary to a paper like the one discussed, but that they had a rule in Washington to send flowers after death. He thought that the structural history of a region should be split to consider the stages of breaking, as well as the locus of deposition, and that Dr. Newhouse's study involved only the latter.

Non-Metallics

Among the important late developments in cement technology are closed-circuit grinding and classification of raw materials in wet-process plants, filtration of the slurries on modified Oliver filters, and the introduction of waste-heat boilers, according to information brought out at the meeting on non-metallics. Air separation for purification of clay has found wide acceptance. In the field of refractories the development of bricks with a high alumina content stands out. Diamond-set saws are used with good results in slate quarries. Flotation of fluorspar is a commercial success at Rosiclare, Ill. Crushing of feldspar in rolls with subsequent electromagnetic purification to remove iron has been introduced in Tennessee. Much progress has been made by the Bureau of Mines in studying methods of extracting potash from polyhalite.

Attendance at the annual banquet, held in Hotel Commodore, was smaller than in most recent years and the speeches were shorter, more satisfaction being derived from the second than the first factor. Presentations of the James Douglas, William Lawrence Saunders, and Robert Woolston Hunt awards were made to the winners, respectively W. H. Peirce, F. W. Maclennan, and E. S. Davenport. J. V. N. Dorr presented Mr. Peirce, Scott Turner presented Mr. Maclennan, and G. B. Waterhouse presented Mr. Davenport. Waldemar Lindgren, dean of American geologists, was made an honorary member of the institute, being presented by George Otis Smith. Ralph Crooker, member of the institute since 1881, spoke on behalf of fellow members of his class, who, as participants in the affairs of the organization for a continuous period of fifty years, have been added to the A.I.M.E. Legion of Honor. W. H. Bassett, retiring president, in his presidential address discussed briefly the several divisions and committees which constitute the organization. He emphasized the fact that all of the advantages and none of the disadvantages of a separate organization are available for groups such as the Institute of Metals, Petroleum, Iron and Steel, and Coal divisions. R. E. Tally, the incoming president, was introduced to the assemblage.

Mine Ventilation

In presenting his paper on the progress in metal mine ventilation D. Harrington stated that flows of nitrogen and methane were encountered unexpectedly in sinking a shaft at a potash property in New Mexico. One explosion occurred but no one was hurt. Sinking of the remaining 700 ft. of the shaft was performed with the workers using electric cap lamps. R. Peele called attention to the simultaneous driving of parallel tunnels, apparently for ventilation purposes, by the Spaniards in the Peruvian Andes prior to the close of the seventeenth century.

H. I. Smith suggested, in the course of the discussion of the paper on the effect of air conditions on workers by R. R. Sayers, that perhaps certain dust-laying solutions instead of water might be used advantageously in wet drilling. The growing popularity of the moving-picture film dealing with carbon-monoxide hazards, which the U. S. Bureau of Mines prepared, was mentioned by Mr. Harrington.

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Economic Geologists Present Medal to David White

Dr. David White, of the U. S. Geological Survey, is the fourth recipient of the Penrose Medal, awarded by the Society of Economic Geologists for "unusually original work in the earth sciences." Presentation of the medal was made at a dinner at the Princeton Club, New York on Feb. 17. Prof. L. C. Graton presided. Dr. R. A. F. Penrose, Jr., the donor, was unavoidably absent.

Many tributes were paid Dr. White. Dr. Frank D. Adams brought greetings from the Canadian Institute of Mining and Metallurgy and the Engineering Institute of Canada; Dr. J. J. Galloway, of Columbia University, spoke in behalf of the Palaeontological Society of America and the Society of Economic Palaeontologists. Dr. Sidney Powers was to have spoken for the American Association of Petroleum Geologists, but was unable to be present. Dr. George Ashley, of Pennsylvania, was spokesman for the State Geologists; Dr. Charles P. Berkey for the Geological Society of America; and E. A. DeGolyer for the A.I.M.E. Prof. Edward Sampson, of Princeton, secretary of the society, read some telegrams from absentees.

These formal greetings over, the remaining speakers dwelt on the career and achievements of Dr. White. Dr. M. R. Campbell spoke of his correlation of formations based on fossil plants. Dr. K. C. Heald contrasted with the old methods of petroleum prospecting the new methods made possible by Dr. White. Dr. Lindgren spoke of the influence of White's work on the metal-mining industry. Dr. W. C. Mendenhall paid a tribute to the guest of honor, saying that from the beginning to the present, he had devoted himself, wholly without diversion, to creative work and to inspiring work on the part of others. He stressed the fact that the Society of Economic Geologists was bestowing its highest award on a worker in pure geology. To these tributes Dr. White responded briefly.

Sherritt Gordon to Start One Mill Unit Now

Operation of one 600-ton unit of the 1,800-ton concentrator built at Sherridon, Man., by Sherritt Gordon Mines has been started. An official announcement, made by the company's secretary, states that the board of directors at a meeting on Feb. 12 decided that, in spite of the existing low prices of metals, the mine would be put into production, starting with one unit of the mill. Nothing was said in the announcement concerning recovery of the zinc content of the ore, but that for the present only a copper concentrate, containing gold and silver as well, will be made, seems probable. The ore handled in the one unit will probably come entirely from the West orebody, where the grade of copper is higher.

The copper-bearing gossan of Sherritt Gordon, in northern Manitoba, about 100 miles northeast of The Pas, was first discovered in 1922 by a Cree Indian, Phillip Sherlett. It was acquired by the present company in 1927, and early in 1928 intensive exploration and construction of mining plant was started. By October, 1929, a total of 5,254,500 short tons of ore, averaging about 2.5 per cent copper and 3 per cent zinc, had been proved. The company decided to build a 1,500-ton mill, but by the addition of an extra Hardinge ball mill, the nominal capacity has been increased to 1,800 tons in three units of 600 tons each.

Contracts have been made with Hudson Bay Mining & Smelting for the purchase of power from its Island Falls development, in Saskatchewan, and for smelting of Sherritt's copper concentrate at the Flin Flon plant of Hudson Bay. No contract was made for treatment of zinc concentrate, as the Lindsley interests, which control Sherritt Gordon, had planned to construct an electrolytic zinc plant in eastern Canada in conjunction with Consolidated Mining & Smelting. The depressed zinc market has interfered with these plans, particularly since the mines in the Rouyn area of Quebec that were counted on for an additional ore supply are now shut down. When Sherritt Gordon does start recovery of its zinc, the concentrate will probably be shipped to the Consolidated Mining & Smelting electrolytic plant at Trail, B. C.

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House Committee Approves Mines Building Bill

The House Committee on Mines at Washington, D. C., has favorably reported the bill recently passed by the Senate authorizing establishment by the U. S. Bureau of Mines of an experiment station on the campus of the University of Maryland, near Washington. The project was indorsed at a hearing before the commitee Feb. 6 by J. H. Hedges, assistant to the director of the Bureau, and other Bureau officials. Mr. Hedges explained that the Bureau will not obtain any larger quarters in the new Commerce Building than it now has in the old building in the city and that it is in urgent need of a field laboratory so located that it will permit the technical heads of the Bureau to carry on research work in addition to discharge of their administrative duties.

Representative Arentz, of Nevada, advocated the transfer of the Bureau of Mines back to the Interior Department, declaring that it has become an orphan since it has been under the jurisdiction of the Department of Commerce. Representative Arentz doubted the advisability of establishing the Maryland station, because, he said, laboratory facilities could be provided in the Interior Building.

■

Balatoc Specimen to Be Shown at Paris Exposition

A specimen of Balatoc gold ore, with an approximate value of $40,000 per ton, is to be a part of the Bureau of Science exhibit of the Philippine Islands, at the Colonial Exposition to be held at Paris. This sample was taken from 1,200 west heading, 364 vein of the mine operated by the Balatoc company, a subsidiary of Benguet Consolidated Mining. Ore on this vein, 6 ft. across, has given assays up to $5,400 a ton.

The exhibit, which was selected as a specimen of interest to scientists as well as for its high value, is ribboned marcasite, rhodonite, and calcite, highly silicified, carrying free gold and a small amount of calavarite. Officials of the company are confident that this ore, though it may be passed by without a glance by laymen unacquainted with gold mining, will attract the attention and study of geologists and mineralogists.

■

Two-Year Subsidy Granted Mansfeld by Government

The arrangements made by Mansfeld A.G. für Bergbau u. Huttenbetrieb, operating copper properties at Eisleben, Germany, calls for a maximum annual subsidy to the copper-producing units of the company of 5,400,000 marks in 1931 and 1932. This money must be used only to insure continuation of present copper-mining and smelting operations. In addition, the company can obtain as much as 1,400,000 marks annually for improvements in its equipment. This sum is expected to be used largely for development of new copper orebodies.

Repayment of the subsidy is to start in January, 1933. It will amount to between 25 and 75 per cent of the company's earnings until the full amount has been repaid. Obligation to repay the 10,800,000 marks that will be received to maintain operations will expire in 1945. However, no time limit is set to the repayment of the sums received for capital expansion.

■

Complete Mill at Searchlight

Reconstruction of a 100-ton mill at the old Duplex mine of Searchlight Gold, at Searchlight, Nev., has been completed. The mine, which was closed in 1921, was taken over by the present company in 1928. A 600-ft. vertical shaft was sunk, a Diesel power plant was built, and extensive development undertaken under the direction of W. J. Loring. The mill has been equipped with flotation units.

When operated by Duplex Mining, a considerable tonnage of ore was produced from the oxidized zone of the orebody. Mill heads averaged about 8.6 per cent lead, 2.3 per cent copper, 1.3 per cent zinc, 0.9 oz. of gold, and 4.9 oz. of silver to the ton. In the sulphide zone, which will now be exploited, the copper content increases and the lead content decreases. Ore occurs in quartz monzonite, veins varying from 2½ to 5 ft. wide.

Senate Committee Favors Pitman Silver Report

On Feb. 18 the Foreign Relations Committee of the U. S. Senate, at Washington, D. C., authorized Senator Key Pittman, of Nevada, to report favorably his resolution suggesting that the President enter into negotiations with foreign governments with respect to the uses and status of silver as a money. Senator Pittman said at the time that he might report the resolution within the following two or three days, the time depending upon when he can get immediate action.

Senator Pittman, as head of a subcommittee of the Foreign Relations Committee, conducted extensive investigations last summer and fall into the effect of the decline of the price of silver on our trade with the Far East. The report of his subcommittee was presented to the chairman of the committee on Feb. 12, and outlined three steps with regard to the silver situation: first, that the President take up with the British government for India the question of suspending the policy of melting silver coins for sale as bullion; second, that the President call an international conference with a view to obtaining agreements for the stabilization of silver; and, third, that an international silver loan be made to China. Press reaction to this report has indicated that although the first two suggestions have met with fairly widespread favor, the possibility of obtaining action on the third is small. There is considerable doubt whether Chinese authorities are in favor of such a loan.

■

Sunshine Ore Reserve Nearly Tripled During 1930

Ore reserves at the Sunshine Mining property, in the Coeur d'Alene district, Idaho, were estimated at 787,000 short tons of silver-lead ore on Dec. 31, 1930, according to C. C. Samuels, manager. This is nearly triple the estimate of 273,000 tons made at the end of 1929, despite the extraction of a record tonnage of 147,948 tons. Mill capacity has been increased to 500 tons daily, and development is being carried to the 1,700 level.

Operations have been placed on a five-day week basis at both mine and mill so as to lessen somewhat the drain on the ore reserves at current low metal prices without throwing any men out of employment. The grade of ore has decreased from 1.3 per cent lead, 0.024 per cent copper, and 27.8 oz. of silver to the ton, to 0.5 per cent lead, 0.02 per cent copper, and 15.7 oz. of silver to the ton. Despite the present low silver price, however, a profit is being made.

■

Organize Group to Visit Finland

An international excursion to study the Pre-Cambrian areas of Finland is being organized for this summer. This excursion is designed especially for geologists and will include several excursions to points of interest near Tampere and Helsingfors, as well as a general meeting at Helsingfors for discussion of six or seven topics connected with the geology of Finland. Those interested are urged to get in touch with Dr. J. J. Sederholm, director of the Geological Survey of Finland, at Boulevard 29, Helsingfors, Finland.

Strike Tintic Bullion Ore Near North Lily Line

A body of zinc-lead ore has been struck in the Tintic Bullion property of Chief Consolidated, at Eureka, Utah, by North Lily. It is on the 900 level, about 1,000 ft. from the North Lily line. North Lily has a lease on this ground as well as the Baltimore group of Chief Consolidated and two claims of Tintic Standard. The new strike is associated with the shale in a zone parallel to that in the North Lily. The company is drifting to cut the Ophir limestones on their dip.

In the Eureka Bullion, North Lily-Knight is following rich ore. Tintic Standard has been following a gold-bearing fissure in the quartzite in leased ground in the Eureka Lily. Tintic Standard is also entering East Tintic Consolidated ground, leased from Chief Consolidated with a crosscut driven from the 1,300 level of the Eureka Standard shaft.

The Big Hill shaft of North Lily-Knight, also in the East Tintic district, has reached a depth of 1,700 ft., where a flow of water averaging 20 g.p.m. has been struck in the Teutonic formation. Drifting has been started on the 1,600 level to connect with the 1,200 level of the North Lily shaft, now down 1,350 ft. About 1,100 ft. of drifting, or two months' work, will be necessary to connect with the drift from the North Lily 1,200 level. By making this connection, the company will not need to install a pumping plant at the Big Hill shaft, since the North Lily company has one installed on its 900 level capable of handling more than 700 g.p.m. not in use. The water flow struck in the North Lily last summer has dropped from more than 700 g.p.m. to less than 20 g.p.m., all of which is disappearing down a fissure.

A sinker pump will be used to pump the water in the Big Hill shaft to the 1,600 level. Water from the 1,200 level of the North Lily will be pumped to the 900 by a booster pump.

The Big Hill shaft will be sunk about 650 ft. more to reach the Cambrian quartzite, after which exploration will be started in the Ophir limestone lying just above the quartzite.

■

Kernick Mill Shut Down

After running about ten days, the Kernick 50-ton mill, at Sodaville, Nev., has been shut down for further adjustment. The recovery was not as high as expected. Samples of the ore have been sent to the Mackay School of Mines for tests. Experiments will be made, which should be simple, as the ore indicates a free milling. Samples of ore from other mines in the district will also be submitted, as the Kernick mill was intended to serve as a custom mill as well as to treat its own ores.

■

Resume Milling at Flowery

The Flowery mine, in Six Mile Canyon near Virginia City, Nev., is now handling about 125 tons a day, mostly low-grade gold ore. The mill has been running about three weeks in experimental work. Thirty men are employed. The ore is being drawn partly through the tunnel from which an upraise was put up a long time ago to tap the glory hole, and partly through the shaft from the 100 and 200 levels. A plan is being worked out for further development of the mine and to settle down to a production from mill heads of even values. So far the grade has been rather erratic.

Ore will be treated from the Belmont Uncle Sam property, as soon as a road can be built and a sampler erected for custom ores.

■

Bill to Permit Suspension of Assessment Work Fails

Efforts to secure legislation for the suspension of assessment work on mining claims have failed again. There was some support for a bill of that character, but Senator Oddie, of Nevada, chairman of the Mines and Mining Committee, states that it would have been useless to call a meeting of the committee to consider the bill, as it was apparent that it would not be approved. At the request of Senator Oddie, the Secretary of the Interior reiterated his opposition to the measure on the ground that assessment work will contribute something toward the relief of unemployment.

■

State Geologists at Capital Urge Closer Co-operation

Closer co-operation among the individual state geological commissions was urged on Feb. 14 at the meeting in Washington, D. C., of the Association of American State Geologists, H. A. Buehler, director of the Missouri Bureau of Mines and Geology, called attention to the lack of co-operation among states in working out a uniform mapping system. Some states have different scales in their system, he pointed out. Furthermore, he stated that it is necessary for states to adopt a uniform nomenclature for their maps. Similar geologic situations in different states are identified under different terminologies, which are confusing, he explained.

W. C. Mendenhall, acting director of the Federal Geological Survey, said that there were common problems among the states which would have to be worked out through closer co-operation. Each state should know the needs of the other states so that their common needs might be considered as a whole, he said. An informal exchange that can keep the association in touch with state problems should be developed, Walter F. Pond, of Tennessee, added.

■

Utah Copper Bids for Rights

Negotiations are under way for disposal of certain surface rights on the property of Utah Metal & Tunnel, at Bingham, Utah, to Utah Copper. The sum of $250,000 is said to be involved. Under the terms of the contract as drawn, Utah Copper will dispose of waste and haul in supplies for Utah Metal and will in no way interfere with the latter's operations, which are entirely underground. A somewhat similar arrangement was recently made between Utah Copper and Bingham Metals for surface rights on the latter's property. The need for dumping privileges so as to dispose of the vast tonnage of waste that has to be removed from its Bingham Canyon open pit is responsible for these transactions by Utah Copper. Utah Metal & Tunnel is shipping a small tonnage of lead-zinc ore to the International Smelting concentrator at Tooele.

Many Deals Completed in Holdings at Scossa, Nev.

A summary of events in the last few days at the new Scossa camp, 154 miles from Reno and 54 miles north of Lovelock, Nev., shows options taken totaling about $250,000, of which about $30,000 is first payments made to date. Nine quarter sections of Southern Pacific lands have been bought by various parties at $15 an acre. Pershing County has put a crew of road-builders on the 12-mile stretch from the Seven Troughs road to the camp. Carl Stoddard, Reno surveyor, is surveying the district and townsite. Ten new houses have been built or moved in and fifteen tents. The shaft on the Onizema claim, owned by Olsen and Scossa, has been sunk to a depth of 40 ft. in ore with a streak of high grade.

E. M. Dawes, who purchased the Scossa brothers' original location claims, has moved in a large amount of mine supplies, but has not yet started work in the discovery shaft, as contract to purchase prohibits removal of any ore until another payment has been made. A first payment of $20,000 was made last week. George Keough and I. N. McDowell made first payment of $2,000 on a price of $20,000, for two 40-acre quarter sections of Southern Pacific land. Dr. Rhodes, of Reno, made a cash payment on Feb. 14, of $1,000 for the Wild Animal claim. The total price is $16,000. J. E. Bevis, E. H. Mead, and Dr. Hood, all of Reno, made first payment on the North Star Extension group and started trenching.

Herbert Hamlin, Jr., took in two 5-ton truckloads of camp and mine supplies and started work on the Gum Shoe group. Five companies have been incorporated, but none of them are taking over any of the properties above mentioned. Scossa Gold Belt Mines, controlled by Colonel W. Scott Proskey, has three men trenching on its claims, southeast of the discovery claims.

■

A. S. & R. Completes Changes at Rosita Zinc Smelter

American Smelting & Refining has now completed and put into operation a modern eight-block retort plant at its Rosita zinc smelter, in Coahuila, Mexico. This is the only Mexican zinc smelter now producing. The roasting department consists of four Skinner roasters, 20-ft. inside diameter, and twelve hearths. A Cottrell plant is connected with this unit. One Dwight-Lloyd sintering machine, 65 ft. long and 63 in. wide, is connected with the baghouse.

Concentrates treated in the Rosita smelter are from the company's own mines in Mexico. The plant has a capacity of about 9,000 short tons of concentrate monthly. Average grade of concentrate is about 58 per cent zinc. The sulphuric acid plant operated in connection with the smelter has a monthly capacity of 1,000 tons of 100 per cent sulphuric acid.

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U. S. S. R. & M. Rejects Ebner Offer

An offer made by Alaska Juneau Gold to U. S. Smelting, Refining & Mining for its Ebner properties was recently declined. The Ebner properties adjoin those of the Alaska Juneau at Juneau, Alaska, and have been developed under a working agreement for several years past by the Alaska Juneau company. Both properties carry low-grade gold deposits.

Unemployed in Tri-State Fields Working Old Properties

Little has been heard of the old expression that the Tri-State zinc-lead district is the "poor man's district" during the last few years of consolidations and deep mining in the Picher section of the district. With the coming of a depression that has caused widespread unemployment, however, the poor man is again taking his place as a producer in the district. Hundreds of unemployed miners are gouging in the shallow lead fields of Galena, Webb City, Oronogo, and Duenweg. It is estimated that these small prospects are turning in from 50 to 100 tons of high-grade lead ore a week, with a value of $2,000 to $4,000. Recently, George Moore, ore buyer for St. Louis Smelting & Refining, dispatched a car of lead ore to his principals with more than fifty separate items.

A score of companies have been formed to gouge in the old walls of the Oronogo Circle cave-in. In the last few years, more than $100,000 worth of lead has been produced from this cave-in, according to officials of American Zinc, Lead & Smelting. Hand windlasses are dotting many of the old districts of the Joplin area. The horse hoister is again in vogue. Several old walking-beam pumps can be seen working in various parts of the district.

The accompanying picture shows a horse hoister on the old Southside land, at Galena. More than 400 shafts have been sunk on this 80-acre tract and still many prospectors continue to unearth a little lead and zinc. The prospectors in the picture are working in an old cave-in, but are using the horse hoister to raise their ore. The derrick is built of scrub oak and the other material, what there is of it, is second-hand. But several hundred unemployed miners are making enough to keep the wolf away from the door until the Picher mines reopen.

■

Propose Nevada Gold Bonus

A bill introduced in the Nevada State Assembly by Assemblyman Branson proposes a bonus to stimulate prospecting for new gold deposits in the state. The bill calls for the payment of $1,000 by the state to any prospector discovering a gold deposit from which $10,000 is produced within six months of discovery. Additional payments of $1,000 per $10,000 produced will be made until a total of $10,000 has been paid out. To qualify for the bonus, prospectors must file an affidavit with A. J. Stinson, State Mine Inspector, certifying the date of discovery. The bill seems likely to pass, although the amounts paid may be somewhat reduced.

■

Small Quicksilver Plants Started

During December and January three new quicksilver plants were placed in operation in the United States: Antelope Springs Mining, of Lovelock, Nev., installed a 15-ton rotary furnace. Rainbow Mines installed a 10- to 20-ton Herreshoff furnace at Terlingua, Tex. Mercury Corporation of America installed an 80-ton rotary furnace at Santa Margarita, Calif. All three plants were designed by C. N. Schuette, metallurgical engineer.

Gougers at work in the Tri-State area

Gow Considers Ore Outlook at Main Range Property Good

North Butte Mining "confidently anticipates" development of high-grade primary copper orebodies in its Main Range mine, east of the Continental Fault, at Butte, Mont., according to a statement issued by Paul A. Gow, president of the company. Recently some indications of copper have been encountered east of the fault on the 2,200 level. For many years, the theory has been held that the area to the east of the Continental Fault at Butte has little promise of ore. No large orebodies have yet been developed in this area. The part of Mr. Gow's statement dealing with the Main Range development follows:

"There has been no retrenchment in development work being carried on in your East Side properties. During the year ended Dec. 31, 1930, development work in the Main Range mine has amounted to 5,893 linear feet, or an average monthly advance of 491 ft. This work has been done largely on the 2,200 level, which is the present lowest level of the mine, and is now proceeding to the east of the Continental Fault, where recently a small vein was encountered containing high-grade primary copper sulphides, typical of the ores from which Butte's vast copper production has come. This ore occurrence is not in itself of commercial importance except that, together with other indisputable evidences of primary copper mineralization, it proves the occurrence of the typical primary copper sulphides to the east and beyond the Continental Fault where North Butte owns an area in excess of 1.000 acres.

"As favorable vein structures are encountered in the development work in this area, it is confidently anticipated that high-grade primary copper orebodies comparable to those of the Butte Hill will be developed. It is by such pioneer development work that substantial extensions have been made to the proved areas of many of the principal copper producing districts and the efforts which are being put forth in the development of your East Side properties should be similarly rewarded."

Ore Reserves Up 50 per Cent at Wright-Hargreaves in 1930

Although production was the largest in the mine's history, development work at Wright-Hargreaves, gold property in the Kirkland Lake district, was so successful that ore reserves at the end of 1930 were 619,600 short tons, averaging $11.83 per ton, compared with 418,870 tons, averaging $11.30 per ton, at the end of 1929, according to M. W. Summerhayes, general manager of the company. As production during the year was 220,430 tons, the total ore developed was 421,150 tons. The average grade of ore developed was $12.57 and the average grade of ore milled was $12.20, indicating a steady improvement in grade as the deeper levels are opened up. The No. 3 shaft, now down to the 2,400 level, is being continued to 3,000 ft.

During 1930, 17,837 ft. of drifting, 321 ft. of shaft sinking, 6,446 ft. of crosscutting, 2,122 ft. of raising, and 10,884 ft. of diamond drilling was accomplished. All of these figures show increases over development work done in 1929. Total costs per ton of ore milled were cut from $7.044 to $5.962. These figures include general and depreciation charges. The drop was caused largely by a decrease in development costs, as only the amount required to develop the tonnage milled in 1930 was charged against this item. However, milling costs were cut from $1.241 a ton to $1.105 and transportation costs from $1.079 to $1.023.

The most important feature of the year's development work, according to Mr. Summerhayes, was the remarkable persistence of the oreshoots on the 2,250 level, where a total of 2,141 ft. of ore was opened up during the year. The better grade of ore mined in 1930 was to be credited largely to better control of dilution from the walls of the orebodies, as well as to more intensive sampling and supervision in the stopes. In the upper levels, where fill is not available, open-stull stoping is being used. On the lower levels, however, both "horizontal" and "rill" cut-and-fill methods are being used.

■

Moss Mines to Build Mill

Construction of a mill, the first unit of which will have a daily capacity of 100 short tons, will be undertaken at the gold property of Moss Mines, in Moss Township, Thunder Bay district, Ontario. Two shafts have been sunk at this property, the main three-compartment shaft being bottomed at a depth of 400 ft. Development work has been done on the 125, 250, and 375 levels. Norman Fisher, president of the company, estimates developed reserves at 50,000 tons averaging $15 in gold per ton and a substantial tonnage of lower-grade ore. About $500,000 will be provided by financing now under way. This will not only permit mill construction, but also mine and power plant additions.

■

New Ore at Mirabel Quicksilver

A new shoot of quicksilver ore has been opened up at the Mirabel property, south of Middletown, Calif. The Mirabel is an old mine, first operated in 1887. It was mined to the 500 level. The new oreshoot is reported to have been followed for 90 ft., with ore of varying grade.

George J. Young Honored by San Francisco Group

Many mining engineers have been the recipients of medals for outstanding accomplishments in the mining profession and many other engineers have held and do hold offices of prominence. There are many other engineers who are deserving of much praise and commendatory remarks from their fellow associates for their enthusiasm, industry, and friendship. However, seldom does the occasion appear when such feelings of man-to-man are completed and expressed.

On Feb. 6, 1931, 21 San Francisco Section Institute members sat down together at a dinner, which was originated so as to pay due respect to George J. Young, Associate Editor of the *Engineering and Mining Journal*, who is held in high esteem by many of his mining associates for his friendly and optimistic views on life and also his record in the mining industry. The dinner party was held at the Engineers' Club of San Francisco. Those in attendance were Messrs. George J. Young, T. A. Rickard, F. W. Bradley, W. P. Hammon, C. W. Merrill, C. H. Munro, Abbot A. Hanks, L. H. Duschak, F. H. Probert, C. C. Brayton, C. M. Eye, R. A. Kinzie, E. A. Hersam, R. G. Hall, F. L. Morris, Walter W. Bradley, W. H. Grant, George D. Blood, H. C. Carlisle, Walter Stalder, W. H. Blackburn, and James G. Parmelee. The original idea of this dinner in honor of "George" (as most men know him) was developed by T. A. Rickard and P. R. Bradley one evening while commuting across San Francisco Bay to their homes in Berkeley. Mr. Bradley was unable to be present for the party, so the position of master of ceremonies fell on the able shoulders of Mr. Rickard.

At the close of dinner Mr. Young modestly remarked that the occasion was indeed an agreeable surprise to him, though his first thought upon being notified of the affair was, as he expressed it, "Well, I'll be dog-goned." George reviewed in interesting sequence his life's work from the time he was a student in the College of Mining at the University of California, studying under the late and beloved Prof. S. B. Christy, up through his contacts as Professor of Mining, at, respectively, the University of Nevada at Reno, the University of Minnesota, and the Colorado School of Mines. At the latter institution he was closely associated with H. C. Parmelee, President of the School at that time and now Editorial Director of the McGraw-Hill Publishing Company in New York. From the Colorado School of Mines Mr. Young went east to New York to become affiliated with the *Engineering and Mining Journal*, where he remained a few years, following which he was transferred to San Francisco, where he has been Associate Editor of the publication for the past ten years. Everywhere George went he made friends, from the highest in office to the lowest, all of whom have willingly and eagerly assisted him with his many problems of life and human nature.

Practically all of those attending the dinner were called upon by Mr. Rickard to say a few words, and each in turn expressed his great admiration and praise to "George Young" for his valued friendship. R. A. Kinzie brought to notice a developed ability, unbeknown to many, that "George" is an artist and etcher on copper and zinc metal with much recognition having been attained in that field of endeavor with special reference to wind-swept trees of the high Sierra Nevada Mountains. F. W. Bradley stated that he always admired "George's" ability to keep up to date on all the technic of mining details, and in addition was very happy to be considered as one of his friends. E. A. Hersam spoke of "George's" admiration and love for his fellow men, for his thoroughness of purpose, his enthusiasm, mildness of manner, heartiness, integrity, and his high moral purpose. R. G. Hall remarked that "George" was always willing to do a favor and that he would outdo himself to accomplish the end. Further Mr. Hall said to George, "We honor you, admire you and love you." Other speakers were Messrs. Munro, Probert, Eye, Hanks, Merrill, Blackburn, and Grant.

As a memento of the occasion, a book entitled, "Reminiscences of an Outdoor Life," by William Kent, was presented by those present to the honored guest of the evening. Signatures of those in attendance were inscribed on the flyleaves of the book.

JAMES G. PARMELEE,
Secretary, San Francisco Section A.I.M.E.

■

Proposed Legislation May Affect California Mines

Among the many bills proposed in the California Legislature, now in session at Sacramento, are several that will affect the mining industry. One of these plans to establish the Trinity and Klamath rivers as fish and game districts and would prohibit muddying the waters of these river systems from July 1 to Nov. 1 of each year. It applies to the drainage basin of both rivers and would interfere with gold dredging and hydraulic gold mining operations on the Trinity River. Another bill provides for a 10-ft. discovery shaft, or its equivalent, for mineral locations.

Among bills which are not directly concerned with mining, but which would affect the industry, are a proposal for unemployment insurance; a revised income tax law, with depletion allowance along the lines of the Federal Revenue Act; and not fewer than eighteen bills dealing with compensation insurance.

■

U.V.X. Shows Little Change

Despite extraction of 301,562 short tons of ore in 1930, ore reserves at the Jerome mines of United Verde Extension, in Arizona, were well maintained. On Dec. 31, 1930, they were estimated at 600,000 short tons averaging 7 per cent copper, a decrease of 25,000 tons and 0.5 per cent in grade from the reserves at the end of 1929. In view of the pessimistic statements made by company officials concerning the life of the mine, this showing is regarded good. The new ore was developed north of and above the 1,207 area, according to J. S. Douglas, president of the company.

Although there has been some lessening in lateral development at the property (the total for 1930 being 13,135 ft., compared with 18,079 ft. in 1929), 6,301 ft. of diamond drilling was done in 1930. The production cost per pound of copper produced, before depreciation, depletion, and taxes, was 8.49c. in 1930, compared with 8.46c. in 1929.

Montreal Copper Refinery Starting Operations

Operations have been started at the new Canadian Copper Refiners plant, in Montreal East, Que., which has been built to refine blister copper from the Noranda and Hudson Bay smelters. The first refined copper will probably not be available for consumption until the end of April, as the electrolytic cells have to be filled with cathodes first. Capacity of the plant is 75,000 tons of refined copper annually. No provision is made for refining of precious-metal content of the blister treated. The precious-metal residue will be cast into doré metal and shipped to the United States for refining.

Construction of the plant is estimated to have cost $5,000,000. It is entirely owned by three companies—Noranda Mines, operating mines, mill, and smelter at Rouyn, Que.; British Metal Corporation, a smelting and investment company with interests throughout the British Empire; and Nichols Copper, subsidiary of Phelps Dodge, operating refineries at Laurel Hill, N. Y., and El Paso, Tex. The plant is 1,040 ft. long and has a maximum width of 264 ft. It is expected to employ from 800 to 1,000 men when in operation.

Noranda is now reported to be producing about 3,000 short tons of copper monthly from its smelter and Hudson Bay is producing about 1,500 short tons monthly. Noranda's capacity, however, is about 5,000 tons monthly. Blister from the Noranda smelter has been shipped to the Laurel Hill plant of Nichols since production started in 1927. Hudson Bay put its smelter into operation only last October, and such blister as has been produced has also gone to Laurel Hill.

Canada Wire & Cable is building a wire-bar mill adjoining the refinery at Montreal East. The mill will require about 10,000 tons of copper annually. As Noranda has a large interest in Canada Wire & Cable, Canadian Copper metal will be sold to this plant exclusively.

■

Canadian Institute to Meet Next Month at Ottawa

For the first time since 1926, the annual convention of the Canadian Institute of Mining and Metallurgy will convene in Ottawa, Ont., at the Chateau Laurier, from March 4 to 6. Already preparations are being made to welcome a large attendance of members from all parts of Canada and fom the United States. Papers on the latest developments in Canadian mining and treatment practice will be delivered. Several social functions have been arranged, including a dinner-dance on the evening of March 6.

Among the papers to be given will be a symposium on the little-known mineral deposits of northern Canada. G. G. Duncan will present a paper on exploration work in the Northwest Territories. J. P. Norrie will discuss the developments around Great Bear Lake, and John Drybrough will give a paper on the nickeliferous areas on the west coast of Hudson Bay.

Among those who have already signified their intention to be present are the president, J. S. DeLury, of Winnipeg, and F. W. Gray, president-elect, of Sydney, N. S. The local committee is under the chairmanship of A. E. MacRaye, and no efforts are being spared to make the gathering one of the most notable in the history of the institute.

BRIEF NOTES

Ashley Gold Mining. While excavating for a power-house building, on its claims at Bannockburn, Ont., the company encountered a new vein, 150 ft. east of and parallel to its original discovery. Though narrow, the vein is said to be of high grade. A complete steam plant, shaft-sinking equipment, and 15 tons of supplies have been shipped to the property via Elk Lake. About 60 men are employed. A shaft will be put down to 500 ft., with levels at 125-ft. intervals. Two other veins have been discovered on the Garvey claims and a discovery of gold-bearing float has been reported on the Davidson claims, 1 mile to the northwest.

Atlas Mining. During 1930 the company opened an oreshoot, 140 ft. long and 8 ft. wide, in the eastern section of its holdings, near Wallace, Idaho, according to W. E. Greenough, president of the company. This shoot appears to be the upper portion of an orebody, but development has not been undertaken below the tunnel level. Before attempting this work, however, the company will continue to test other promising sections of the mineralized shear zone on the tunnel level. A test shipment of one carload of concentrate was made. This concentrate was produced from Atlas ore shipped to the Gold Hunter mill over the company's new 2,000-ft. aërial tramway. The concentrate assayed 44.7 per cent lead, 2.2 per cent zinc, and 16.4 oz. of silver to the short ton. Atlas has recently completed payment for an 80 per cent interest in the Carney group of nine claims, adjoining its holdings to the east.

Bunker Hill & Sullivan. An option on a group of seventeen claims on Slate Creek, in the Lead Hills district, 12 miles northeast of Metaline Falls, Wash., has been taken by the company. The deal involves $200,000 to be paid over a period of four years. No work has been done at depth on the properties, although the outcrops are said to be extensive. Surface work is now under way.

Callahan Zinc-Lead. Diamond drilling will be undertaken at the company's Galena mine, in the Coeur d'Alene district, to ascertain the continuation of the Galena vein at depth. The holes will be drilled from the 800 and 1,000 level workings on the South vein, which is about to be explored on the 1,200 level. No work has been done on the Galena vein below the 600 level.

Colorado School of Mines. Negotiations are under way for the purchase by the school of Wild Horse Park, 18 miles northwest of Pueblo, Colo. The park is expected to be used for establishment of permanent headquarters for field geology, geophysics, and petroleum research. If consummated, the proposed transaction will involve the sale of 2,000 acres of land. For the last six years, the school has conducted a summer camp in this park for its students. C. B. Timberlake, representative of Colorado in the U. S. House of Representatives at Washington, D. C., has introduced a bill authorizing sale of the land to the school at a minimum price of $1.25 per acre

Consolidated Lead & Zinc. The No. 10 mill, in the Tri-State district, is being dismantled. Ore from the mine will hereafter be treated at the No. 14 mill, where a large capacity is available, according to F. N. Bendelari, president of the company. Development at depth at the LaSalle mine has checked the results of diamond drilling. A new shaft has been sunk to develop this ore and the old shaft has been deepened to the same level. A new shaft has also been sunk at No. 9 mine. On the whole, however, the company's operations are greatly curtailed and will remain curtailed until metal prices improve. Production of ore in 1930 was 219,930 short tons, compared with 582,192 in 1929. The grade improved from 5.28 per cent zinc to 6.65 per cent.

East Butte. Surface and underground equipment at the Pittsmont property, at Butte, Mont., has recently been sold to the Machinery & Supply Corporation of America, Inc., of Seattle. This company is reselling the equipment to operators. East Butte directors have just declared a liquidating dividend of $2 a share. Although equipped with a blast-furnace smelter, East Butte has in recent years shipped all ore to the plants of Anaconda Copper for treatment. The smelter was closed in 1924 when Davis-Daly Copper, which had been shipping ore to it under contract, suspended shipments. East Butte output reached a peak of 12,300 short tons of copper in 1918, but has been averaging about 4,000 tons annually since 1924.

Genii Consolidated Mines. The company has taken over the mining property of Genii Mining, at Magalia, Butte County, Calif. The new company has a capitalization of $2,500,000 in shares of $1 par. A second storage-battery locomotive and additional ore cars have been ordered. The first unit of a washing plant to handle gravel from the Mammoth Channel will be installed. It will handle 100 cu.yd. of gravel daily and will gradually be increased to 400 cu.yd. daily. The Mammoth Channel has been tapped through a 3,200-ft. channel and extensive development work has been done. The company states that pay gravel has been exposed for more than 800 ft. in length, 50 to 250 ft. in width, and 6 to 15 ft. in thickness.

Gold Standard Mining. The company has acquired the Sunnyside mine, in Owyhee County, Idaho, and the Allan and Diamond Hill groups, in Broadwater County, Mont. All three are gold properties, of which only the first has been a producer in the past. A small mill on the Sunnyside property will be remodeled, and development through a new two-compartment shaft will be undertaken if present financing plans are successful. Some silver and lead also occurs in the Sunnyside ore.

Golden Chariot-War Eagle Mines. The Cumberland, Louisiana, and Montreal claims, together with mill and equipment, have been added to the company's holdings near Silver City, Owyhee County, Idaho. They were purchased from H. S. Greene, of Cohoes, N. Y., who acquired them from the Gault estate, of Montreal, Canada, former owner and operators. The Cumberland shaft, 410 ft. deep, produced some high-grade gold-silver ore during the Silver City boom, late in the nineteenth century, but heavy water flow made continued operation impossible. Golden Chariot-War Eagle will develop the property through its Golden Chariot shaft, which cut the vein at a depth of 800 ft. Equipment will be moved to the portal of the Sinker Tunnel, which connects with the shaft. Kirby Thomas, of New York, is president of the company.

Golden Horseshoe Mining. Operations have been started at the Guilford and Pacific claims, near Placerville, Calif. The property consists of patented gold claims, held by the company under lease and option. Four tunnels have been driven on the Guilford claims, and a ten-stamp mill was operated in 1925. The total area is 1,480 acres.

International Mining Exchange. This organization is opening offices at Albuquerque, N. M., under the leadership of R. A. Chase, president of Chase Mines, Inc. It will act as broker and agent for parties interested in selling mining properties and in securing capital for development and exploration. It is a direct representative of the New York Mining Exchange. All properties will be subjected to a staff examination before acceptance for negotiations.

Kennedy Mining & Milling. Preparations have been completed for sinking the winze at the mine, near Jackson, Calif., to the 4,950 level, which will be the deepest in the mine. Interesting results are being obtained from the flotation unit installed in the company's cyanide plant.

LaRoche Mines. Federal Kirkland and Buffalo Rouyn have united to form this company, which will undertake development of the McMahon group of two claims, with a total extent of 85 acres. The holdings are about 2 miles south of the Hollinger Consolidated property at Timmins, Ont. A program of surface trenching is to be started immediately in an effort to correlate several interesting outcrops disclosed by previous operators. The mine office will be at Timmins, Ont.

Mining Corporation. Production of cobalt from the company's Frontier mine, at South Lorrain, Ont., is increasing. This property was virtually shut down in 1928, producing less than 100 short tons of ore in 1929. However, re-examination of the upper levels early in 1930 showed some cobalt and high-grade ore in the "D" stope workings. Production started in March and has gradually increased. In the second quarter of the year, output was 100,127 oz. of silver and 57,349 lb. of cobalt: in the third quarter, 174,897 oz. and 95,881 lb.; and in the fourth quarter, 107,069 oz. and 139,121 lb.

Montana Mines. In January, the Spring Hill flotation plant, near Helena, Mont., treated more than 7,200 short tons of ore, an average of 260 daily. This tonnage is now being increased. The company is sinking an interior shaft to 200 ft. from the main haulage tunnel.

Santa Rosa Mining. Water was encountered at a depth of 350 m. in shaft sinking at the company's gold-silver-lead property, Santa Rosa, Zacatecas, Mexico. The necessary pumping equipment has been installed and sinking has been resumed. Levels have been driven to the contact, along which oreshoots have been developed, at depths of 232, 282, and 332 m. Some interesting and encouraging results have been obtained, according to J. H. M. Shaw, chairman of the board of directors of the company. However, development at and below the water level is expected to determine the future of the mine, and shaft sinking will be continued to 432 m. The company's mill, which was shut down

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EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

Complete Mill Addition at San Francisco Mines

London, Feb. 16. — The increase in mill capacity of San Francisco Mines of Mexico, at San Francisco del Oro, Chihuahua, Mexico, has been completed, and the plant can now handle 500,000 metric tons annually, compared with 300,000 metric tons up to the end of 1929. However, the second stage in the expansion of the company's operations has had to be postponed, according to the Earl of Denbigh, chairman of the board of directors of the company, at the annual meeting. This second stage involved the acquisition of a 50 per cent interest in the Clarines mine for £53,000 and construction of a cable tramway to connect the mine with the San Francisco concentrator. Postponement of the consummation of the project was caused by adverse market conditions, the Earl pointing out in this connection that during the year under review (that ended Oct. 31, 1930) the average decline in the prices of lead, zinc, and silver was 22 per eent.

. . . . Milling operations are now on the scale of 400,000 metric tons of lead-zinc ore annually, or about 33,500 tons monthly, with recovery of both zinc and lead contents. Ore reserves have been greatly increased. On Oct. 31, 1930, blocked-out reserves of both oxide and sulphide ore was estimated at about 1,763,000 metric tons, compared with 1,458,900 metric tons at the same time in 1929. Reserves of ore only partly blocked out were estimated at about 554,000 metric tons, compared with 435,600 metric tons on Oct. 1, 1929. These increases are 27 and 21 per cent, respectively, and indicate a reserve in the Frisco mine sufficient for at least four and a half years of capacity operation.

. . . . The main haulage drive on the 450 level of Mount Isa Mines, in northern Queensland, Australia, has cut a new vein, 15 ft. wide. It assays 13.8 per cent lead, 8.2 per cent zinc, and 7.8 oz. of silver. The main haulage shaft is now down to about 650 ft. In addition, about 400 ft. of lateral development work is being done weekly.

. . . . Underground equipment at Wiluna Gold, operating near Meekatharra, Western Australia, is now complete. The company expects to start stoping on a small scale this month. The crushing and milling plants will probably go into operation some time early in March. Capacity is 40,000 long tons monthly, or, with an average grade of about 35s., an output of about £60,000 in gold monthly.

. . . . The 200-ton flotation plant of South American Copper, at Aroa, Venezuela, has finally been put on a successful basis. Recovery has increased to 88 per cent of the total copper content of the ore on an operating basis of two shifts daily. The full capacity will be used when reagents now in transit arrive at the property.

. . . . Although official announcement may be delayed, an agency message states that it is reliably reported that the Federated Malay States has adopted the tin-export quota scheme, already approved by Nigeria, Bolivia, and Netherlands East Indies. Committees are being appointed to represent the several states as well as the central government. Confirmation of this report could not be obtained from the Malayan agency or the British Colonial Office.

. . . . Hugh Marriott has sailed to Panama for his annual tour of inspection of the properties of Panama Corporation there. He is expected to be present when the first milling unit is put into operation at the Remance mine.

. . . . A net profit of £409,762 is reported by British South Africa, holding and investment company operating in the Rhodesias, for the year ended Sept. 30, 1930. This is a decrease of £444,135 from the income in the previous year. Dividend payments of £449,432 were made during the year, indicating the dividend was not earned. The company reports a loss of £4,000 on sale of some of its investments.

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Drilling Program at N'Changa Being Brought to a Close

London, Feb. 17.—Directors of Rhodesian Congo Border Concession feel that a sufficiently large tonnage of ore has been proved in the N'Changa and N'Changa West Extension areas, Northern Rhodesia, so the drilling program which has already outlined more than 100,000,000 tons of ore, of which well over 30,000,000 tons is of high grade, will gradually be brought to a close. No new holes will be put down and only those holes now in course of drilling will be completed. Underground development and equipment activities of the company are to be increased. The head office is now at N'Kana, where Rhodesian Anglo-American, the largest stockholder, also maintains headquarters.

. . . . The work of consolidating the operating organizations of Rhodesian Congo Border with N'Changa Copper and Bwana M'Kubwa, the two companies which it recently absorbed, is now being undertaken. The new arrangement will probably be announced soon. This consolidation of the technical staff is presumably one of the reasons for suspending operations at the Bwana mine, which had been operating at a loss.

. . . . W. B. Daly, Reno Sales, and F. A. Linforth, respectively manager, chief geologist, and assistant chief geologist of Anaconda Copper at Butte, Mont., sailed on Friday, Feb. 13, for Northern Rhodesia. This is believed to be the first occasion on which technical members of the Anaconda staff have visited the new Rhodesian copper fields.

. . . . H. S. Munroe, of Rhodesian Anglo-American, is returning to Rhodesia from a visit to London. A. D. Storke, managing director of Rhodesian Selection Trust and Roan Antelope, is making his annual trip of inspection of the properties. These engineers will find the mines making remarkable progress. A leading engineer remarks that construction is ahead of schedule at every Rhodesian property, largely as a result of the quick adaptation of native labor to the work. Roan Antelope is now officially expected to start production some time this year, probably about August or September. Mufulira Copper is expected to start in 1932.

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Brief Notes

(Continued from page 193)

early in 1930 because of the continued drought in northern Mexico, was put into operation in July. Even with present low metal prices, production is paying for development.

Sherman Lead. Development on the 1,700 level of the property, at Wallace, Idaho, has disclosed a good grade of silver-lead ore over a distance of 550 ft. in the Leary vein. Ore was cut off in the western face of the drift by the Mart fault. Exploration work has failed to disclose its continuation beyond the fault, according to Henry L. Day, manager of the company. Production from the mine, which was at the rate of about 300 tons daily early in 1930, is still suspended, pending an improvement in metal prices.

Shenandoah-Dives Mining. At its Mayflower mine and mill, near Silverton, Colo., production has been increased to a basis of 375 tons of gold-lead-copper ore daily, although the mill was originally designed for only 300 tons. It has been in operation for about one year. Shipments of concentrate to the smelter at Leadville, Colo., totaled 37 carloads in January and 38 carloads in December. An average of about 25 was maintained during most of 1930. As a result of the closing of the Sunnyside mill, at Eureka, Shenandoah-Dives is now the largest producer in the San Juan basin.

United Verde Extension. Shaft sinking at the Vulture gold property, near Wickenburg, Ariz., is now down more than half of the distance to the quartz vein, which the company expects will be struck at about 450 ft. U.V.X. holds an option on a majority of Vulture stock until 1932. D. R. Finlayson, president of Vulture, has taken an option on the Hubbard-Ritter gold prospect, on which two shallow shafts have been sunk.

Western Empire Mines. Milling has been resumed by this company at the Royal Mines property, north of Copperopolis, Calaveras County, Calif. The mine carries a flat-dipping quartz vein, with silver-gold oreshoots. Development is through an incline shaft. A 120-stamp mill was built about 1915. Production by the original owners and later lessees was spasmodic.

MARKET AND FINANCIAL NEWS

Total Stocks of Copper Down 11,510 Tons

Combined stocks of blister and refined copper declined to the extent of 11,510 tons during the month of January, the third successive reduction in stocks held by North and South American producers. The stocks of blister showed a reduction of 8,162 tons, and holdings of refined were down 3,348 tons. Production of refined copper in January totaled 102,458 tons, a decline of 3,908 tons, according to the American Bureau of Metal Statistics.

United States mine production for January was 47,741 tons, down 985 tons from the December total.

Summary of Copper Statistics

In Tons of 2,000 Pounds

Production:	December	January
Mines, United States	48,726	47,741
Blister, North America (a)	74,186	66,770
Blister, South America (a)	20,752	24,064
Refined, No. & So. America	106,366	102,458
World, blister basis	136,252	(c)
Stocks (end of month):		
No. and So. America:		
Blister (b)	218,799	210,637
Refined	367,175	363,827
Totals	585,974	574,464
Great Britain (d)		
Refined	6,443	7,431
Other forms	2,153	1,747
Totals	8,596	9,178
Havre	3,896	3,920

(a) Includes direct-cathode copper. (b) Includes in process. (c) Not yet available (d) Official warehouses only.

U. S. Mine Production

	December	January
Porphyry mines	19,000	18,809
Lake mines	4,876	4,307
Vein mines	21,142	21,225
Custom ores	3,708	(a) 3,400
Total crude production	48,726	47,741
Daily rate	1,572	1,540

(a) Partly estimated.

Smelter Production

	December	January
United States	60,022	53,429
Canada	9,508	8,852
Mexico	4,656	4,489
Totals	78,186	66,770

Shipments

North and South America

	Export	Domestic	Total
1926	525,861	902,174	1,428,035
1927	641,865	824,844	1,466,709
1928	674,221	983,460	1,657,681
1929	586,594	1,119,409	1,706,003
1930			
January	30,358	69,932	100,290
February	29,597	61,879	91,476
March	30,523	73,644	104,167
April	29,196	50,017	79,213
May	49,115	75,760	124,875
June	44,818	71,887	116,705
July	42,466	75,436	117,902
August	38,319	56,810	95,129
September	37,873	65,169	103,042
October	38,246	75,703	113,949
November	45,051	62,693	107,744
December	39,169	69,854	109,023
Total	454,731	808,784	1,263,515
1931			
January	45,597	60,209	105,806

Financial Notes

TONOPAH EXTENSION MINING, operating a silver-gold mine at Tonopah, Nev., reports production of 1,507,378 oz. of silver and 14,770 oz. of gold from 98,486 short tons of ore in 1930. Cost of silver production, after crediting gold content, was 34.4c. an ounce. The mine is now closed. Fiscal statement at the end of 1930 showed current assets of $57,091 and current liabilities of $31,269. Extraction was 93 per cent of the silver content and 95 per cent of the gold content of the ore. Average value of ore mined was $8.77 per ton and operating costs were $7.84.

PARK CITY CONSOLIDATED, operating a silver property at Park City, Utah, reports net smelter receipts of $66,233 for 18,643 short tons shipped in 1930. The company at the close of the year had current assets of $18,548 and current liabilities of $14,782.

SUNSHINE MINING, operating a silver mine in the Coeur d'Alene district, Idaho, reports total income of $816,115 during 1930 and an operating profit of $234,568. The company paid $238,211 in dividends. At the close of the year, the surplus was $130,824, compared with $281,070 at the close of 1929. The difference was written off to depreciation and depletion reserve.

LAKE VIEW & STAR, operating at Kalgoorlie, Western Australia, reports net profit of £38,990 for the year ended June 30, 1930. Production was £494,629 from 151,049 long tons of ore, of which 86,070 was on company account and the remainder was purchased from tributers. The profits have been allotted to the appropriation account for development and equipment of the property.

NEW JERSEY ZINC, operating zinc mines and smelters in New Jersey, Pennsylvania, Virginia, Colorado, and New Mexico, reports a total income in the fourth quarter of 1930 of $873,367, compared with $1,050,880 in the preceding quarter. Total income for the year was $5,013,403, according to a compilation of the quarterly reports. After payment of $2.50 per share in dividends, a balance to surplus of $105,243 was left. An additional 50c. dividend was paid from accumulated surplus.

MCINTYRE PORCUPINE MINES, operating a gold property in the Porcupine district, Ontario, reports gross income of $1,220,363 in the quarter ended Dec. 31. Net earnings, before depreciation, were $544,543, compared with $542,241 in the preceding quarter. The nine months since April 1 show an increase of $107,988 over the earnings during the corresponding period in the previous year.

HOLLINGER CONSOLIDATED, operating a gold mine at Timmins, Ont., estimates net operating profit in 1930 at $4,083,881 in a preliminary statement recently issued. Production was $10,263,504 and income from investments and other sources was $639,426. In 1929, operating profit was $4,041,079.

ALASKA JUNEAU in January mined and tramed to mill 355,370 tons, from which estimated receipts were $318,000, or 89.48c. per ton; operating expenditures were $189,500, or 53.32c. per ton, and operating profit was $128,500, or 36.16c. per ton. Other expenditures totaled $2,000, leaving $126,500 to surplus for the month.

COMPANIA DE SALITRE DE CHILE, the giant Chilean nitrate combination, will float a $45,000,000 bond issue, of which $34,000,000 will be offered in the United States and England. The loan will not be guaranteed by the Chilean government. Proceeds will be used for payment of $22,500,000 guaranteed the govment in 1931 and for working capital.

Senate Approves Copper Cost Data Inquiry

A resolution directing the Tariff Commission to investigate the cost of production in the United States and in foreign countries of all forms of copper mentioned in the free list of the tariff act was approved by the Senate on Feb. 5. Senators Hayden, of Arizona; Wheeler, of Montana; and Vandenberg, of Michigan, introduced the resolution. The investigation could not be ordered under the flexible provision of the tariff act, because there is no duty on unmanufactured copper. The resolution therefore refers to Section 332 of the act, which authorizes such investigations and reports to be made upon the request of the President or either branch of Congress. The Tariff Commission is asked to report on the differences in the cost of mining and smelting foreign and domestic copper for the last three calendar years, in order to make a proper comparison between marketing conditions in periods of prosperity and depression.

Zinc-Ore Reduction Plants Being Decentralized

S. D. Strauss
Assistant Editor

In the innumerable discussions of business depression that one reads these days, a factor that is often mentioned is the desire of each nation to become as self-sufficient as possible. Countries long considered essentially purveyors of raw materials hold ambitions of becoming industrial powers. Improved methods of communication, widespread technical knowledge, and utilization of hydro-electric sources of power, if mineral fuels are not available, have contributed to this change.

In few fields is this change more marked than in that of zinc production. Belgium, Germany, Great Britain, and France were for a long time the centers for the treatment of zinc ore and concentrate from mines other than those in the United States. Availability of fuel and proximity to their great iron and steel markets contributed to this pre-eminence. Within the last few years, however, the development of electrolytic zinc processes and the improvement in utilization of hydro-electric power have worked a change. Canada, Australia, Rhodesia, and Mexico have developed zinc plants of their own. Undaunted by a market which, in 1930 at least, has offered comparatively low returns for their production, they have steadily increased output.

The accompanying table indicates what has happened within the last six or seven years. For purposes of clarity, the production of the United States has been entirely omitted from the calculations, since this country, as a result of its tariff, is, to a certain extent, independent of the world market. The individual figures given in the table are for metal production by reduction plants. Mexico, for instance, although it is credited with only 16,000 tons of metal, actually mines ore containing more than 150,000 tons, but exports most of it to American and European plants.

The countries have been divided into three groups. The first group, "ore-exporting countries," is composed of countries that, in 1924, exported considerable quantities of ore for treatment. Africa and Mexico, in fact, at that time exported their entire production. In six years, it will be noted, this group increased their slab zinc output 150 per cent. Their share of the world's production was enlarged by 7.3 per cent. Further expansion seems certain. New plants have recently been brought into production in Canada and Italy. Proposals have been made for additional units in Australia, Mexico, and Peru, the last-named of which now exports its entire output of concentrate.

The second group, "semi-independent countries," consists of Germany and Poland. Both of these countries obtain considerably more than 50 per cent of their slab zinc output from domestic mines. The A.B.M.S., in fact, credits them with an aggregate mine production containing 220,700 metric tons of extractable zinc in 1929, compared with metal output of 280,736 metric tons.

In the third group are the "dependent" countries, which obtain the great majority of their ore supplies from foreign sources. These are the countries that will find themselves with the hardest fight on their hands. They are the only ones to report a decreased output in 1930. A correspondent from London writes of the stringency of ore supplies these smelters are experiencing. The reason is obvious. Most of the strong mining companies now operate their own reduction plants. Weak ones are bowing before the storm of depression.

Zinc Output in Short Tons of Metal

Country	1924	1929	1930
Ore-Exporting Countries			
Australia	52,205	56,010	61,643
Canada	27,443	86,049	121,467
Italy	6,569	17,206	20,422
Mexico	.....	16,643	(b) 16,000
Africa	.....	13,575	20,055
Spain	14,084	13,030	11,790
Total	100,301	202,513	251,377
Percentage of world output (a)	17.0	20.5	24.3
Semi-Independent Countries			
Germany	45,745	112,185	109,550
Poland	102,614	186,324	200,637
Total	148,359	298,509	310,187
Percentage of world output (a)	25.2	30.4	30.0
Dependent Countries			
Belgium	178,242	220,316	(b) 195,000
France	63,614	100,984	99,996
Great Britain	43,098	65,294	54,432
Netherlands	20,051	28,342	25,634
Total	305,005	414,936	375,062
Percentage of world output (a)	51.9	42.2	36.3
Elsewhere	33,617	66,415	95,656
World output (a)	587,342	982,373	1,032,282

Figures are taken from the A.B.M.S. (a) Output outside the United States, which is excluded for reasons stated in main body of article. (b) Estimated.

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United States Zinc Stocks Show Moderate Increase

The January zinc statistics, released on Feb. 6 by the American Zinc Institute, revealed an increase of 1,500 tons in stocks of zinc on hand in the United States on the last day of the month. The stocks were estimated at 145,076 tons, which compares with 143,576 tons in December, and a high of 145,139 tons last November. The daily rate of production for January was 1,049 tons, against 1,054 tons in the preceding month.

Domestic zinc statistics, in tons, for December and January, according to the American Zinc Institute, follow:

	Dec.	Jan.
Production	32,682	32,522
Production, daily average	1,054	1,049
Shipments	34,245	31,022
Stock, end of month	143,576	145,076
Retorts operating end of month	33,640	35,635
Retorts operating, aver. for month	33,190	35,137
Unfilled orders	26,651	30,251

Note: There were no exports of zinc in December and only one ton was shipped abroad in January.

United States Lead Stocks Increased in January

Total stock of refined lead in the hands of United States producers at the end of January amounted to 113,145 tons, an increase of 9,898 tons for the month, according to the American Bureau of Metal Statistics. The gain in stocks was not unexpected, as shipments during January were even smaller than in the preceding month. Shipments for January totaled 37,633 tons, against 40,595 tons in December.

Lead production, stocks, and shipments, in tons, follow:

Production	Dec.	Jan.
From domestic ore	48,517	43,405
Secondary and foreign	4,692	3,892
Totals	53,209	47,297
Stock at beginning (a)	90,402	103,247
Total supply	143,611	150,544
Stocks at end (a)	103,247	113,145
Shipments by difference	40,364	37,399
Shipments reported	40,595	37,633

(a) Domestic only.

The United States lead refinery statistics account for refineries at Omaha, Selby, Perth Amboy, Carteret, Collinsville, East Chicago, Herculaneum, Grasselli, Federal, Kellogg, Galena, Newark, Matawan, Indianapolis, Joplin, and Ontario.

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American Metal Income Down

Net income, after all charges, of American Metal in 1930 was $1,827,579, according to the company's annual report. This compares with $3,189,403 in 1929. Interest charges of $1,950,744, largely representing the interest on the $20,000,000 note issue floated by the company during the year, and lower metal prices, were largely responsible for the decrease in net income. Production of all metals save gold from the company's smelters and refineries decreased. The consolidated surplus account shows a surplus on Dec. 31, 1930, of $10,640,690, compared with $11,075,549 at the end of 1929. Total assets of the company are estimated at $92,644,974, of which $32,580,947 represented investments at cost. The market value of these securities on Dec. 31, 1930, was $24,697,859.

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Consolidated Lead & Zinc

An operating profit in 1930 of $107,575, made by Consolidated Lead & Zinc, Eagle-Picher mining subsidiary in the Tri-State district, was turned into a net loss of $53,600 by deduction of depletion, depreciation, and other charges. Comparable figures for 1929 were an operating profit of $329,519 and a net profit of $64,025. Production of zinc concentrate declined from 29,354 short tons to 16,474; of lead concentrate, from 4,317 to 2,391. The average price received per ton of zinc concentrate was $26.51, compared with $34.10 in 1929. Current assets are placed at $248,755 on Dec. 31, 1930, current liabilities at $13,556 and total assets at $2,558,703.

World Silver Production Shows Decline for 1930

Output of silver during 1930 by countries producing about 87 per cent of the world's total was 211,428,000 oz., against 227,880,000 oz. in 1929, and 222,367,000 oz. in 1928, according to the American Bureau of Metal Statistics. Production statistics, in thousands of ounces, for the last three years, follow:

	1928	1929	1930
United States	56,149	60,180	50,234
Canada	20,328	21,587	23,447
Mexico	108,536	108,701	105,204
Peru	21,818	21,163	16,634
Australia	8,132	8,969	8,854
Burma	7,404	7,280	7,055
Totals	222,367	227,880	211,428

January, 1931, production in the United States amounted to 3,664,000 oz., against 3,713,000 oz. in December. Canada is credited with a silver output of 1,932,000 oz. for January, against 2,043,000 oz. in the preceding month. Peru produced 918,000 oz. in the first month of the current year, against 508,000 oz. in December, 1930. Output in Autralia during January was 670,000 oz., against 674,000 oz. in December. January statistics for Mexico have not yet been announced.

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Nevada Consolidated Net Down

Report of the Nevada Consolidated Copper Company and subsidiaries for the quarter ended Dec. 31, 1930, shows a loss of $608,801 after ordinary taxes, inventory adjustments, and depreciation, but before depletion, comparing with profit of $143,556, before federal taxes and depletion, in preceding quarter, and profit of $3,213, 711 in final quarter of 1929. Profit for the year 1930, as compiled from quarterly reports, and subject to year-end adjustments, totaled $1,921,051 after ordinary taxes, inventory adjustments and depreciation, but before federal taxes and depletion, against $19,241,893 in previous year.

Howe Sound Profit Drops

Net profit of Howe Sound, operating in Canada and Mexico, dropped from 456,865 in the third quarter of 1930 to $391,137 in the fourth. The value of metals produced was $3,177,235, compared with $3,444,088. Production for the quarter was 27,873,909 lb. of lead, 10,463,109 lb. of copper, 19,996,134 lb. of zinc, 1,033,143 oz. of silver, and 3,605 oz. of gold. Lead and zinc outputs show small increases over, and copper and silver outputs small decreases from, the preceding quarter.

Total production for 1930, compiled from quarterly reports, compares as follows with 1929 totals:

	1929	1930
Copper, lb.	43,032,641	45,266,927
Lead, lb.	75,276,511	90,430,797
Zinc, lb.	53,455,920	59,120,464
Silver, oz.	2,973,016	3,606,977
Gold, oz.	14,252	12,770

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Texas Sulphur Production

During 1930 the three sulphur producers in Texas—Texas Gulf, Freeport Sulphur, and the Duval Texas Sulphur—produced a total of 2,560,197 tons, an increase of 202,563 tons compared with the 1929 output.

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SHERMAN LEAD, operating a lead-silver mine in Idaho, reports net operating profit of $75,927 in 1930. One dividend totaling $36,750 was paid. At the end of the year, the cash balance was $64,515. Production was 6,307,917 lb. of lead and 210,848 oz. of silver from 29,847 short tons of ore.

KILO-MOTO, gold property operating in the Belgian Congo, reports production of 4,513 kg. 514 grams (159,211 oz.) of gold in 1930, compared with 4,055 kilos 311 grams (143,046 oz.) in 1929 and 3,398 kilos 874 grams in 1928. The 1930 production is the highest the company has ever recorded.

National Lead 1930 Earnings Show Big Decrease

Net earnings of the National Lead Company in 1930 were $4,675,098 after depreciation, depletion and taxes, equivalent to $7.58 a share on the common stock, after preferred dividends. This compares with net earnings of $10,222,897, or $25.49 a share, in 1929. Part of the profit in 1929 arose, however, from the sale of capital assets. The balance sheet as of Dec. 31, 1930, showed current assets of $48,803,172. Inventories showed a slight decrease, amounting to $17,437,173, compared with $18,314,892 at the end of 1929.

The company's tonnage sales last year decreased an average of 24 per cent from the 1929 sales. Edward J. Cornish, president, said that this was the largest decrease ever recorded in the company's history and that it indicated the severity of the depression. Mr. Cornish stated that he saw little in the company's current sales that was particularly encouraging, but added that the company would have no difficulty in maintaining the present dividend rate of $5 a share.

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Domestic Lead Shipments

The industrial classification of domestic lead shipments, for December and January, according to the American Bureau of Metal Statistics, in tons, follows:

	Dec.	Jan.
Cable	12,521	10.379
Ammunition	1.568	2.634
Tin foil	548	821
Batteries	3,574	4.877
Brass-making	177	329
Sundries	1,869	1.756
Jobbers	165	449
Unclassified (a)	20,173	16,388
Totals	40,595	37,633

(a) Of the shipments reported as unclassified, about one-third goes into white lead and about 30 per cent into red lead and litharge, as averages. Other important outlets in this classification are sheet and pipe, solder, and babbitt metal.

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QUEMONT MINING CORPORATION, which owns property adjoining Noranda Mines, at Rouyn, Que., has purchased a 7.5 per cent interest in Ashley Gold Mining for $25,000. This is equivalent to 210,000 of the 3,000,000 shares outstanding. Ashley Gold is developing the new gold discovery at Bannockburn, Ont. Mining Corporation of Canada controls both Quemont and Ashley.

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Correction: The net change in the price of Rhodesian Anglo American shares for the year 1930, as indicated on p. 142 of the Feb. 9 issue, should have read minus 18s. 1½d., and not plus 18s. 1½d.

Complete Market News and Prices

THE semi-monthly magazine you are now reading carries only a condensed review of important market news and price movements. For buyers and sellers of ores, metals, minerals, and scrap who require reliable information as soon as it is available, we now provide *Metal and Mineral Markets*, which goes to press at the close of the metal-market week each Wednesday. It is printed at high speed and is in the mails that evening. In compact form, ready for insertion in a ring binder, it is ideal for desk and reference use. It carries the standard *E.&M.J.* quotations used in contracts the world over, recognized as authoritative and dependable. *Metal and Mineral Markets* is priced to subscribers in the United States and its possessions at $2 per annum; to countries in the Americas but outside the United States, $5; elsewhere, $10 yearly: 52 issues. Address *M.& M.M.*, 36th St. and 10th Ave., N.Y.City.

Copper Advanced to 10.25c. on Improved Buying—Active Call for Lead

New York, Feb. 19, 1931.—Demand for copper has improved, especially for export, and the price was raised to 10¼c., Connecticut basis, a net gain of three-quarters of a cent in the last two weeks. Reports on the movement of fabricated copper products were a little more encouraging. Total sales of lead for the period were excellent, and the market strengthened in spite of another fairly large increase in stocks. With zinc concentrate offered more freely in the Tri-State district, offerings of the metal increased and the price eased off slightly. London staged a bullish demonstration in tin, based on hopes of an early settlement of the curtailment plan. Silver again made a new low. The firmer trend in share values on the Stock Exchange has been a factor in expanding operations in the major metals, for consumers appeared to take a more hopeful view of the situation.

Copper Higher

The feature in copper was the excellent demand from Europe, which set in as soon as the price dropped below the 10c. basis. On Feb. 7 the export quotation was reduced to 9.80c., c.i.f. European ports, to bring the foreign price in line with 9½c. domestic basis. Demand from abroad increased at once and continued at a good rate at subsequent advances to 10.05c. and 10.30c. Domestic business also increased, about an average two weeks' volume being disposed of. To take care of the business, large producers entered the market—a notable development, for they have sold little since last November. The better feeling in Wall Street, together with a moderate expansion in demand for copper products, brought out quite a change in sentiment. The January statistics were construed as favorable, total stocks showing a reduction of 11,510 tons, of which 3,348 tons consisted of refined copper.

On Feb. 18 the domestic price was raised to 10¼c., Connecticut basis, with fair sales late on that day at this figure. Copper Exporters, Inc., advanced the export price 25 points, to 10.55c., c.i.f. usual ports, on Feb. 19. Export sales for the month to date amounted to 31,000 long tons.

Zinc Unsettled

Offerings of zinc increased as soon as it became apparent that the market for concentrate was somewhat easier. A good tonnage of zinc concentrate sold in the Joplin market on the basis of $26 for Prime. Demand for zinc was moderate. Sellers, in order to move the metal, had to come down in their views to the extent of including second quarter business on the 4c. St. Louis basis. On Feb. 18 it was reported that 4c. might be shaded on prompt metal.

Lead Advances to 4.60c.

The contract price of American Smelting & Refining was raised 10 points on Feb. 19, establishing the quotation at 4.60c., New York. The St. Louis market responded with an increase of 5 points, the quotation in that territory moving up to 4.35c.

The price of 4.50c., New York, and 4.30c., St. Louis, prevailed on all business transacted during the fortnight ended Feb. 18. The demand was active, with the bulk of the business for shipment in February and March, though several lots were booked for April, and a little was sold for May. The buying was quite general in character. The unfavorable January statistics were apparently fully discounted.

Tin Firmer

Tin prices have advanced, but it is thought on this side that manipulation in London is chiefly responsible. News concerning restriction of output continues favorable, though no official announcement has yet been made.

Silver Makes New Low

The silver market has been quiet but the price steadied in the last two days on the approach of the Chinese New Year, which started on Feb. 17. New York touched a new low of 25⅜c. on Feb. 16, which was caused more by the absence of buyers than pressure to sell.

Zinc Concentrate

Early in the period the market for zinc concentrate in the Tri-State district exhibited a firmer tone, with sellers reluctant to accept offers of $26. Production has been increasing in some directions and on Monday, Feb. 16, sellers appeared quite anxious to accept $26 basis for Prime. Shipments came from three new mines in the second week of the period, two of them in Kansas and one in Missouri, the latter from Stotts City, where there has been no mining in more than 25 years.

Lead concentrate was nominally unchanged throughout the period at $45 per ton, for basis 80 per cent.

Other Metals

Quotations cover wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., delivered, Alcoa commercial and mill ingot, 99 and 98 per cent, 23.30c.; Alcoa No. 12 alloy, 22c.; metallurgical ingot, 94 per cent plus, 23.30c.; 98@99 per cent, 22.90c. London, £85, less 2 per cent, per long ton, for 98 per cent ingots and bars.

ANTIMONY—Per lb., duty paid, Chinese, spot, 7.10c.; futures, 7c. Cookson's "C" grade, spot, 12⅞c. "C.M.C." grade, 99.9 per cent, spot, 10¾c. London, Chinese, spot, £22 10s. per long ton.

BISMUTH—Per lb., in ton lots, $1.25. London, 5s.

CADMIUM—Per lb., 55c. Average price for January was 67.115c. London, 1s. 9d. to 1s. 10d.

CHROMIUM—Per lb., 97@98 per cent grade, 85@90c. per lb. contained chromium, maximum 1 or 2 per cent iron.

COBALT—Per lb., delivered: Metal imported from Belgium in the form of rondelles, 97@99 per cent, spot, $2.50. Discounts on contracts. London, spot, 10s. Nominal.

INDIUM—Per gram, minimum 99 per cent, $14@$15.

IRIDIUM—Per oz. $160 for 98@99 per cent sponge and powder. London, £33@£35.

MAGNESIUM—Per lb., ingots (4x16 in.), 99½ per cent, 48c., in 100-lb. lots or more; 2½- or 3-lb. sticks (1⅛x27 in.), 53c., 100-lb. lots or more. London, 2s. 9d.@3s. for 99 per cent ingots or sticks.

MANGANESE—Per lb., 95@97 per cent, 42c.

MOLYBDENUM—Per lb., in 10- to 50-lb. lots, C.P. powder, $9.50; 97 per cent, $6.50@$7. (Usually sold as calcium molybdate or ferromolybdenum, which see.)

NICKEL—Per lb. electrolytic cathodes, 35c.; shot and ingot made from remelted electro, 36c.; for single lots of spot metal. London, per long ton, £170 @175, as to quantity.

OSMIUM—Per oz., $65@$70. Nominal. London, £16@£16 10s.

PALLADIUM—Per oz., $19@$21. London, £3 15s.@£4.

PLATINUM — Per oz.; Official price of leading interest, $34. Cash transactions between dealers and refiners at several dollars less. London quotes £6 10s. to £6 15s.

The average price of Colombian crude platinum, basis 85 per cent platinum, for the month of January was $25 per oz.

QUICKSILVER—Per 76-lb. flask, $100. Inquiry has improved slightly, especially on contract business, but offerings continue on a liberal scale, though most sellers appear to be firm on the $100 basis for round parcels. London, £22 12s. 6d. for spot material. Market somewhat easier.

RADIUM—Per mg. radium content, $50 in lots of 4 grams or more, to $65 for 1 gram; smaller quantities, $70.

RHODIUM—Per oz., $55. Nominal.

RUTHENIUM — Per oz., $45@$50. Nominal. London, £9@£9½.

Daily Prices of Metals

Feb.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
5	9.275	25.625	4.50	4.30	4.05
6	9.35	25.90	4.50	4.30	4.05@4.10
7	9.275	25.90	4.50	4.30	4.05
9	9.275	26.125	4.50	4.30	4.025
10	9.575	26.00	4.50	4.30	4.00@4.10
11	9.775	26.25	4.50	4.30	4.00
Av'ge	9.421	25.967	4.500	4.300	4.042
12			Holiday		
13	9.775	25.75	4.50	4.30	4.00
14	9.775	25.70	4.50	4.30	4.00
16	9.775	25.75	4.50	4.30	4.00
17	9.775	26.45	4.50	4.30	4.00
18	9.775@10.025	26.75	4.50	4.30	4.00
Av'ge	9.800	26.080	4.500	4.300	4.000

Average metal prices for calendar week ended February 7, 1931, are: Copper, 9.329c.; Straits tin, 25.644c.; New York lead, 4.558c.; St. Louis lead, 4.379c.; Zinc, 4.067c.; Silver, 27.042c.

Average metal prices for calendar week ended February 14, 1931, are: Copper, 9.635c.; Straits tin, 25.965c.; New York lead, 4.500c.; St. Louis lead, 4.300c.; Zinc, 4.015c.; Silver, 26.625c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East and Middle West is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

Feb.	Sterling Exchange "Checks"	Silver		Gold, London	Feb.	Sterling Exchange "Checks"	Silver		Gold, London
		New York	London				New York	London	
5	4.85 1/2	27 1/8	12 5/8	84s 11 1/2d	12	Holiday	Holiday	12 7/16	84s 11 1/2d
6	4.85 3/4	26 1/2	12 1/4	84s 11 1/2d	13	4.85 1/2	26 1/8	12 1/8	84s 11 1/2d
7	4.85 11/16	26 1/8	12 1/8	.....	14	4.85 1/2	26 3/8	12 5/16	.....
9	4.86	26 1/8	12	84s 11 1/2d	16	4.85 7/16	25 3/4	12 1/8	84s 11 1/2d
10	4.86	26 7/8	12 5/16	84s 11 1/2d	17	4.85 1/2	26	12 1/8	84s 11 1/2d
11	4.86 1/2	27 1/8	12 3/4	84s 11 1/2d	18	4.85 3/8	26 3/8	12 1/4	84s 10 3/4d

Average for week ended February 11: Silver 26.729c.; Sterling Exchange, $4.85844.
Average for week ended February 18: Silver, 26.125c.; Sterling Exchange, $4.85413.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-sixteenths cent premium.

London

Feb.	Copper Standard		Electrolytic (Bid)	Tin		Lead		Zinc	
	Spot	3 M		Spot	3 M	Spot	3M	Spot	3 M
5	43 3/16	43 1/16	46	114 1/4	115 5/8	12 5/8	12 3/4	11 9/16	12 1/16
6	43 3/16	43 1/16	46	115	116 3/8	12 3/4	12 13/16	11 5/8	12 1/16
9	44 9/16	44 1/8	46	116 3/4	118 1/4	13 1/8	13 1/4	12	12 1/2
10	45 1/4	45	47 1/2	116 1/4	117 3/4	13 1/2	13 5/8	12 1/4	12 3/4
11	46 1/8	45 7/8	48 1/2	117 1/2	118 7/8	13 3/4	13 13/16	12 5/8	13 1/16
12	45	45	47 1/2	116 1/2	117 3/8	13 1/8	13 5/16	12	12 1/2
13	44 1/16	44 7/16	47 1/2	115 7/8	117 1/4	13 1/16	13 1/4	12	12 7/16
16	44 7/8	44 3/4	47 1/2	114 3/4	116 1/4	13 1/8	13 1/2	12	12 3/8
17	45 3/4	45 9/16	48 1/2	118 1/4	119 3/4	13 3/8	13 1/2	12 1/4	12 9/16
18	45 5/8	45 1/2	48 1/4	120 3/8	121 7/8	13 1/2	13 5/8	12 7/16	12 11/16

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

SELENIUM—Per lb., $1.80@$2, depending on quantity, for black, powdered, 99.5 per cent pure. London, 7s. 8d.@7s. 9d.

SILICON—Per lb., minimum 97 per cent Si, maximum 1 per cent Fe, 15@17c.

TANTALUM—Per kilo, $91 for C.P. bar or sheet.

TELLURIUM—Per lb., $2.

THALLIUM—Per lb., $12.50@$15.

TITANIUM—Per lb. in 50- to 100-lb. lots, 75 per cent, $5.

TUNGSTEN—Per lb. contained tungsten, 98 per cent, powdered, $1.65.

Metallic Ores

Prices in tons of 2,000 lb., or in "units" of 20 lb., unless otherwise stated.

ANTIMONY ORE—No sales reported. London, per long ton unit, 3s. 9d.@4s. for 60 per cent sulphide ore.

BERYLLIUM ORE—Per unit of BeO, minimum 11 per cent BeO, $4@$5, f.o.b. mines. Per lb. BeO contained, 30c., c.i.f. European ports. Prices nominal.

CHROME ORE—Per long ton, c.i.f. Atlantic ports, Indian ores, $19 for 46@48 per cent Cr_2O_3 ore, and $23.50@$24 for 50@51 per cent ore. London, 77s. 6d. for 48 per cent Rhodesian, and 80s.@95s. for Indian and New Caledonian, according to quality.

IRON ORE—Per long ton, Lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 10c.

Foreign ores, alongside docks Atlantic ports, cargo lots, cents per unit:

North African and Swedish, low-phosphorus, 9@10c.

Spanish and North African basic, 50@60 per cent, 9c.

Swedish foundry or basic, 65@68 per cent, 9½c.

Newfoundland foundry, 55 per cent iron, 9c. Nominal.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, cargo lots, exclusive of duty: Brazilian, 46@48 per cent Mn, 25c.; Chilean, 47 per cent minimum, 29c.; Indian, 48@50 per cent, 26@27c.; Caucasian, 52@55 per cent, 26@27c.; South African, 52@54 per cent, 24@26c., nominal.

Per ton in carload lots:

Chemical grades, powdered, coarse or fine, minimum 80 per cent MnO_2, Brazilian or Cuban, $60. Javan or Caucasian, 85 per cent minimum, $60. Domestic, 70 to 72 per cent, $60, f.o.b. mines.

MOLYBDENUM ORE—Per lb. of contained MoS_2, nominally 35@40c., delivered Pittsburgh. London, per long ton unit, nominal at 32s. 6d.@35s. for 80@85 per cent concentrate.

TANTALUM ORE—Per lb. Ta_2O_5, 70c. for 60 per cent ore. Market nominal. European buyers have bid around 40c., but no sellers.

TIN ORE — No market in United States. London, returning charge on 60 per cent Bolivian, £9@£10 per long ton; on 70 per cent Nigerian, £6 17s. 6d., basis £200.

TITANIUM ORE — Per gross ton, ilmenite, 45@52 per cent TiO_2, f.o.b. Atlantic seaboard, $10@$12, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7 @$8. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Chinese wolframite, $11.50, duty paid. Bolivian scheelite, $11.50 @$12, and domestic, $12.

VANADIUM ORE—Per lb. V_2O_5 contained, 26@28c., f.o.b. shipping point.

ZIRCON ORE — Per ton, 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots. Crude granular zircon, $70, f.o.b. Suspension Bridge, N. Y.; milled, $90.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

Tons of 2,000 lb., unless otherwise noted.

AMBLYGONITE — Per ton, f.o.b. mines, 8@9 per cent lithium oxide, $50@$60.

ASBESTOS — Per ton, f.o.b. Quebec mines, tax and bags included: Crude No. 1, $250@$300; crude No. 2, $200@ $250; spinning fibers, $125@$175; magnesia and compressed sheet fibers, $100@$125; various grades shingle stock, $45@$65; various grades paper stock, $27.50@$35; cement stock, $15@ $20; floats, $10@$12. Market dull and prices largely nominal.

Per ton c.i.f. New York: Rhodesian crude No. 1, $300; No. 2, $200. Nominal.

Per ton, c.i.f. New York: Russian crude, No. 1, $210; No. 2, $150; No. 3, $50. Nominal.

BARIUM CARBONATE (Witherite) — Per ton, 90 per cent, 200 mesh, $47; 100 mesh, $44.

BARYTES—F.o.b. mines, bags extra:

Georgia: Barytes ore, crude, $6.50 per long ton.

Missouri: Per ton, water ground and floated, bleached, $23, car lots, f.o.b. works. Crude ore, minimum 93 per cent $BaSO_4$, less than 1 per cent iron, $6.50; 1 per cent iron and 93 per cent $BaSO_4$, $6, f.o.b. mines.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $6.50@$8, f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6@$7.50, f.o.b. *Arkansas* mines. Pulverized and dried, 56 to 59 per cent Al_2O_3, 8 to 12 per cent SiO_2, $10@ $12.25, f.o.b. *Arkansas* mines; abrasive grade, crushed and calcined, 78 to 84 per cent Al_2O_3, $14@$16, f.o.b. *Arkansas* mines.

Per metric ton, foreign, c.i.f. Atlantic ports: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@ $6.50; one dealer reports $7 for material running 52@54 per cent alumina and 1.50 per cent silica; market fair. Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 4 per cent SiO_2, $6@$8; 56 per cent Al_2O_3, 1.50 per cent SiO_2, $7; 58 per cent Al_2O_3, 3@4 per cent SiO_2, $6.50.

BENTONITE—Per ton, f.o.b. Wyoming mines, dried and crushed, in bulk, $8; in bags, $10. F.o.b. Chicago, selected air-floated, $25.

BORAX — Per ton, carload lots, in bags, crystals, $56; granulated, $50; powdered, $57.50; f.o.b. shipping point.

[1]CELESTITE—Per ton in carload lots, 90 per cent $SrSO_4$, finely powdered, $27.

CHINA CLAY (KAOLIN)—Per ton, f.o.b. *South Carolina* mines, crude lump, No. 1, $5; crushed to ¼ in., $6; pulverized, $9.50.

Florida, washed and crushed, No. 1, $12.50; No. 2, $12.

Imported English, f.o.b. American ports: lump, $17@$20.50 in bulk.

EMERY—Per ton, f.o.b. *New York*, domestic crude ore, $10. Other American ore, delivered to grinders, per gross ton, $15; Turkish and Naxos ore, $30 @$35. F.o.b. *Pennsylvania*, in 350-lb. kegs, Turkish, Khasia, and Naxos grain emery, 6½c. per lb.; American, 3½c.

FELDSPAR — Per ton, f.o.b. *North Carolina*, 200 mesh, white, $18, in bulk; f.o.b. *Maine*, white, 200 mesh, $19, in bulk. Granular glasspar, f.o.b. *North Carolina*, $10, in bulk.

Virginia, No. 1, 325 mesh, $18; 200 mesh, $15@$16; 160 mesh, $14; No. 1 glassmakers', $11.

New Mexico: Crude clean No. 1 potash spar, $4.75; ground, $9.50.

FLUORSPAR — Per ton, f.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $16. Foundry lump, 85-5, $18. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. *Colorado* mines, 82-5, $12.75.

FULLER'S EARTH — Per ton, f.o.b. *Colorado*, $18, various finenesses to minus 90 mesh.

F.o.b. *Georgia* or *Florida*, 30 to 60 mesh, $18; 15 to 30, $16.50; 200 up, $10; 100 up, $7.

GARNET—Per ton, f.o.b. *New Hampshire* mines: crude or mill run, $40; washed, $125.

New York: Adirondack garnet concentrates, $85.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50.

GRAPHITE—Per lb., f.o.b. *New York:*

Ceylon lump, 6½@8c.; chip, 5½@6½c.; dust, 2@3c.; Madagascar flake, 5½@6½c.

No. 1 flake, 8@16c.; fine ground, 5c. upward; amorphous, 3c. upward.

Crude amorphous graphite, $15@$25 per ton, according to grade.

GREENSAND — Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $20. No. 2 grade, $15.

GYPSUM—Per ton, f.o.b. mill, crushed rock, *Iowa*, $2.50; *Ohio* and *New York*, $3. Ground, *Ohio*, $4; *Iowa*, $6. Agricultural, $6@$7. Calcined, $6@$9.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

LEPIDOLITE—Per ton, $50@$60 for ordinary grades. Nominal.

LIMESTONE—Per ton, f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$1.75.

Agricultural, $1 up to $6 per ton, as to grade and point of shipment.

MAGNESITE—Per ton, f.o.b. *California* steel mill points, dead-burned, $29. *Washington:* Dead-burned grain magnesite, $22.

MICA—Per ton, f.o.b. *New Mexico*, scrap, white, $21; off color, $18. Punch, white, for disks, per lb., 10c.; for washers, 8c.

Per ton, f.o.b. *New Hampshire*, roofing mica, $23; snow, $34; 40 mesh white, $40; 60 mesh, $48; 100 mesh, $60; 200 mesh, $75. Clean dry mixed bench and mine scrap, $13.

Per lb., f.o.b. *North Carolina*: Punch, 4@6c.; 1½x2 in., 25@35c.; 2x2, 45@60c.; 2x3, 85c.@$1; 3x3, $1.40 @$1.60; 3x4, $1.80@$2; 3x5, $2@ $2.25; 4x6, $2.75@$3; 6x8, $3.50@ $3.75; 8x10, $5@$7.50. These prices apply both to No. 1 and No. 2 mica. Black-stained mica takes a discount of 10 to 25 per cent from this schedule. White North Carolina mica, 70 mesh, $60 to $80. Biotite, or black mica, $15 a ton, unground.

MINERAL BLACK—(Graphitic shale) —Per ton, 325 mesh, 75 per cent carbon, $22.50, f.o.b. *Virginia*.

MONAZITE—Per ton, minimum 6 per cent ThO_2, $60.

OCHER — Per ton, f.o.b. *Georgia* mines, $17.50 in sacks; $20 barrels; second grade, $10. Buff clay, 98 per cent through 325 mesh, $18.

F.o.b. *Virginia,* dark yellow, 300 mesh, 60 per cent ferric oxide, in jute bags, $19.50.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7.15; 75 per cent, $6.40; 74@75 per cent, $6.15; 70 per cent, $4.65; 68 per cent, $4.10.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4.

Tennessee, ground lime phosphate, 80 per cent through 300 mesh, 33 per cent P_2O_5, $12.80 per net ton, bags extra.

POTASH—Per ton, contracts:

	Bags	Bulk
Muriate of potash, 80@85 per cent, basis 80 per cent	$37.15	$35.55
Sulphate of potash, 90@95 per cent, basis 90 per cent	48.25	46.65
Sulphate of potash-magnesia, 48@53 per cent, basis 48 per cent	27.80	26.20
Manure salt, 30 per cent	22.15	19.15
Manure salt, 20 per cent	15.65	12.65
Kainit, 14 per cent	12.70	9.70

Prices are delivered to Atlantic ports. Discounts up to 4 per cent for early shipment. Spot prices, $1.25@$1.50 per ton higher than on contract.

PUMICE STONE—Per lb., in barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur, c.i.f. United States ports, guaranteed 48 per cent sulphur, Spanish, 13@13¾c.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots, colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. Flawless, for optical purposes, four times above price; larger crystals still higher.

SILICA—Per ton, water ground and floated, in bags, f.o.b. Illinois: 325 mesh, $16@$40 for 92 to 99½ per cent grades. Dry ground, air-floated, 325 mesh, 92@99½ per cent silica, $14@$30. Market steady. Glass sand, f.o.b. producing plant, $1.25@$5 per ton; molding sand, 50c.@$3.50; blast sand, $1.75@$6.

[1]SPODUMENE — Per ton, $50@$60 depending upon lithium content.

[1]STRONTIANITE — Per ton, lump in carload lots, minimum 88@91 per cent $SrCO_3$, $100.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports.

TALC — Per ton, carload lots, f.o.b. works, containers included unless otherwise specified.

New Jersey: Soapstone, ground, $10@$12.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75.

Vermont: 99 per cent through 200 mesh, extra white, bulk basis, $8@$8.50; 97 to 98 per cent through 200 mesh, medium white, $7@$7.50. Packing in paper bags, $1 per ton extra.

Virginia: 200 mesh, $6@$7.75; 325 mesh, $8.75@$10.50.

TRIPOLI — Per ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $15. Double ground through 110 mesh, rose and cream, $17. Air-floated through 200 mesh, rose and cream, $22.50.

Rolled Metals

COPPER — Per lb., sheets, hot-rolled, 19¾c.; wire, f.o.b. mill, 11¼c.

LEAD SHEETS — Per lb., full rolled, 7½c.; clipped, 7¾c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

MUNTZ METAL—Per lb., rods, 16¼c.; plates, 19⅛c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

NICKEL SILVER — Per lb., sheets, 10 per cent, 24½@24⅞c.; 18 per cent, 28@28⅛c. Wire and rods, 10 per cent, 28c.; 15 per cent, 32c.; 18 per cent, 35½c.

PHOSPHOR BRONZE—Per lb., sheets and rods, 5 per cent tin, 31c.; wire, 5 per cent, 31½c.; 10 per cent, 37c.

ZINC SHEETS — Per lb., 9½c., f.o.b. works; ribbon, 9c.; 7 per cent discount on orders for 18 tons or more.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions. London, per long ton, £19 for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE—Per lb. of contained Mo, 85c.

COBALT OXIDE—Per lb., black, 70@71 per cent contained Co, $1.75. London 8s. for black; 8s. 10d. for gray.

COPPER SULPHATE (Blue Vitriol)—Per lb., in car lots, 4c. for either large or small crystals.

GERMANIUM DIOXIDE—Per gram, in 200- to 300-gram lots, $3.50.

SODIUM NITRATE—Per 100 lb., crude natural, in bags ex vessel, Atlantic ports, $2.07.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $15@$18.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6¼c.; French red seal, in bags, 9⅜c.

ZIRCONIUM DIOXIDE—Per lb. in 100- to 500-lb. lots, 87 per cent ZrO_2, commercial, 50c.

Refractories

CHROME BRICK—Per ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M., first quality, $43, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35@$38.

MAGNESITE — Brick, per ton, f.o.b. works, 9-in. straights, $65. Dead-burned grain, $40, f.o.b. Chester, Pa., or Baltimore.

SILICA BRICK—Per M., *Pennsylvania,* $43; *Alabama,* $50@$51; *Illinois* and *Indiana,* $52.

ZIRKITE—Per lb., powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

Alloys

FERROCHROME — Per lb. of contained chromium, 4 to 6 per cent carbon, 65 to 70 per cent chromium, 11c., delivered, on contracts; spot, 11½c. Containing 2 per cent carbon, 67 to 72 per cent chromium, 17½c.; maximum 0.10 per cent carbon, 26c.

FERROMANGANESE — Per gross ton furnace; domestic and foreign, 78@82 per cent, $80@$85, contracts, depending on quantity. Spiegeleisen, 19@21 per cent, $30 for spot carloads.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50, f.o.b. *Alabama* and *Tennessee.*

FERROSILICON — Per gross ton, delivered, 50 per cent, $83.50; 75 per cent, $130; 14@16 per cent, $39, f.o.b. Niagara Falls, N. Y. Spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton, $150, f.o.b. producer's plant.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.10@$1.15, f.o.b. works.

FERROVANADIUM—Per lb. of V contained, delivered, $3.15@$3.50.

SILICOMANGANESE — Per long ton, carload contracts, delivered, $120 for maximum 2½ per cent carbon; $130 for maximum 1 per cent carbon.

SILICON ZIRCONIUM—Per lb., 47@52 per cent Si, 35@40 per cent Zr, 18@21c.

ZIRCONIUM FERROSILICON—Per gross ton, 12@15 per cent Zr, 39@43 per cent Si, $103.50@$108.50.

Iron, Steel and Coke

IRON—Per gross ton, Valley furnaces: Bessemer, $17.50, basic and No. 2 foundry, $17.

STEEL—Per gross ton, base prices, Pittsburgh, billets and slabs, $30; plates and structural shapes, per 100 lb., $1.65; soft steel bars, $1.65.

COKE—Per ton, Connellsville furnace, $2.40@$2.50. Connellsville foundry, $3.25@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis), $5.50; Buffalo and Detroit, $8@$8.50; Birmingham, foundry, $5; furnace, $3.50@$4.50.

[1]Price furnished by Foote Mineral Company, Philadelphia.

Mining Share Prices—Month of January, 1931

Company Name	High	Low	Last	Most Recent Dividend
NEW YORK STOCK EXCHANGE				
Ahumada Lead	0.75	0.37½	0.50	April, 1927 0.12½
Alaska Juneau	9.87½	7.00	8.62½	Ja. 10, Fe. 1, 1931 QI 0.10
American Metal	18½	16½	17	December, 1930 Q 0.25
Am. Metal, pfd			80*	Fe. 17, Mh. 2, 1931 Q 1.50
Am. Sm. & Ref	46½	40½	45	Ja. 16, Fe. 2, 1931 Q 1.00
Am. Sm. & Ref. 2nd. pfd.	100½	93¼	98½	Ja. 30, Mh. 2, 1931 Q 1.50
Am. Sm. & Ref., pfd	131½	129	129½	Ja. 30, Mh. 2, 1931 Q 1.75
Am. Zinc, L. & S.	5.50	4.50	5.00	May, 1917 1.00
Am. Zinc, L. & S., pfd.	30	26	28½	Se. 22, Oc. 1, 1930 Q 1.50½
Anaconda	34½	29½	33	Ja. 10, Fe. 16, 1930 Q 0.62½
Andes Copper	16	13½	14½	Ja. 10, Fe. 9, 1931 Q 0.25
Butte C. & Z.	2.00	1.50	1.75	De. 10, De. 25, 1929 0.50
Butte & Superior	1.87½	1.00	1.12½	De. 13, De. 31, 1929 Q 0.50
Callahan Zinc-Lead	0.75	0.62½	0.75	December, 1920 0.50
Cal. & Arizona	39	37	38	June, 1930 0.50
Cal. & Hecla	9.75	8.00	9.00	June, 1930 0.50
Cerro de Pasco	25¾	23	23½	Ja. 15, Fe. 2, 1931 Q 0.50
Dome Mines	10½	8.87½	10½	De. 31, Ja. 20, 1931 Q 0.25
Federal M. & S.	60	60	60	June, 1927 10.00
Federal M. & S., pfd			85*	No. 25, De. 15, 1930 Q 1.75
Freeport Texas	33½	28½	33	Ja. 15, Fe. 1, 1931 Q 1.00
Granby Con	17¼	15½	16	Ja. 16, Fe. 2, 1931 Q 0.50
Greene Cananea	50	45	46	July, 1930 0.75
Homestake	84½	81	83½	Ja. 20, Ja. 25, 1931 M 0.50
Howe Sound	25	21	23½	De. 31, Ja. 15, 1931 Q 1.00
Inspiration	8.87½	7.62½	7.62½	July, 1930 0.50
International Nickel	16½	14½	14½	Mh. 2, Mh. 31, 1931 Q 0.15
Int. Nickel, pfd	117	114	116½	Ja. 3, Fe. 2, 1931 Q 1.75
Kennecott	26½	22½	23½	De. 5, Ja. 2, 1931 Q 0.50
McIntyre-Porcupine	24½	20½	22½	Fe. 2, Mh. 2, 1931 Q 0.25
Magma Copper	23½	20½	21½	De. 31, Ja. 15, 1931 Q 0.75
Miami Copper	8.62½	7.87½	8.12½	August, 1930 0.375
Mother Lode	0.62½	0.50	0.50	June, 1930 0.10
National Lead	132	118½	120½	De. 12, De. 31, 1930 Q 1.25
National Lead, pfd. A	140½	136	140	No. 28, De. 15, 1930 Q 1.75
National Lead, pfd. B	120	116½	120	Ja. 16, Ja. 31, 1931 Q 1.50
Nevada Con	12½	10½	11½	De. 12, De. 31, 1930 Q 0.25
Park Utah Con	1.62½	1.50	1.50	Je. 14, Jl. 10, 1929 Q 0.20
Patiño M. & E.	12	10½	11	December, 1929 4s.
Phelps Dodge	23¾	19½	20½	De. 13, Ja. 2, 1931 Q 0.50
Rand Mines			27¾*	August, 1930 1.52
St. Joseph Lead	27½	24¼	25¼	Mh. 10, Mh. 20, 1931 Q 0.50
Seneca Copper	1.50	1.12½	1.25	
Tennessee Corp	9.50	8.75	8.75	No. 29, De. 15, 1930 Q 0.25
Texas Gulf Sulphur	50½	45¾	49	De. 1, De. 15, 1930 Q 1.00
U. S. S. R. & M.	22	18¾	20	De. 31, Ja. 15, 1931 Q 0.25
U. S. S. R. & M., pfd.	45	42¾	44	De. 31, Ja. 15, 1931 Q 0.875
Utah Copper	100½	100½	100½	De. 12, De. 31, 1930 Q 2.00
Vanadium Corp	56½	45½	49¾	Fe. 2, Fe. 16, 1931 Q 0.75
NEW YORK CURB EXCHANGE				
Aluminum Co. of Am.	164½	140½	155	
Alum. Co. of Am., pfd.	109½	106½	109	De. 15, Ja. 1, 1931 Q 1.50
Anglo-Chilean Con	11½	7.62½	10	
Bunker H. & S.	50	43–	44	Ja. 22, Fe. 5, 1931 M 0.25
Carnegie Metals	2.50	2.00	2.00	
Con. Coppermines	3.37½	2.75	2.75	
Copper Range	7.75	6.25	7.75	July, 1930 0.25
Cresson Con	1.25	0.25	0.50	April, 1930 0.02
Cusi Mexicana	0.50	0.37½	0.50	
Evans-Wallower	1.62½	1.00	1.12½	
Federated Metals	10½	10½	10½	Ja. 5, Ja. 15, 1931 Q 0.25
Hecla Mining	7.50	7.00	7.50	No. 15, De. 15, 1930 Q 0.25
Hollinger Con	8.50	6.25	8.25	Fe. 11, Fe. 25, 1931 M 0.05
Hudson Bay M. & S.	5.12½	4.25	4.75	
Iron Cap Copper	1.00	0.87½	1.00	
Mayflower Associates	43	40	43	De. 3 De. 15, 1930 Q 0.50
Mining Corporation	2.00	1.75	2.00	De. 4, De. 19, 1929 0.12½
New Jersey Zinc	51	46½	49½	Ja. 20, Fe. 10, 1931 Q 0.50
Newmont Mining	54½	41½	48½	De. 31, Ja. 15, 1931 Q 1.00
N. Y. and Honduras	11½	11	11½	Ja. 20, Ja. 31, 1931 QX 0.50
Nipissing	1.50	1.00	1.50	De. 31, Ja. 20, 1931 Q 0.075
Noranda Mines	18	14½	17½	October, 1930 0.50
Ohio Copper	0.37½	0.25	0.37½	September, 1926 0.03
Premier Gold	0.81½	0.68½	0.68½	De. 12, Ja. 3, 1931 Q 0.03
Quincy			6.00*	March, 1920 1.00
Shattuck Denn	5.12½	3.00	5.00	
So. Am. Gold & Plat	1.50	1.00	1.37½	
Teck-Hughes	7.50	6.25	7.12½	Ja. 17, Fe. 1, 1931 Q 0.15
Tonopah Mining	0.62½	0.37½	0.37½	Se. 30, Oc. 21, 1929 0.07½
United Eastern			0.06½*	
United Verde Ex	10½	8.00	9.25	Ja. 2, Ja. 31, 1931 Q 0.50
Utah-Apex	1.12½	0.87½	0.87½	De. 15, No. 1, 1929 0.025
Yukon Gold	0.25	0.25	0.25	June, 1918 0.02
BOSTON STOCK EXCHANGE				
Ariz. Commercial	1.37½	1.25	1.37½	Fe. 21, Fe. 28, 1931 IL 1.00
East Butte	1.75	1.50	1.62½	Fe. 16, Mh. 4, 1931 2.00
Isle Royale	5.50	4.75	5.00	March, 1930 0.50
Mohawk Mining	18	15½	17	Ja. 31, Fe. 28, 1931 Q 0.25
Old Dominion	3.00	2.87½	2.87½	December, 1918 1.00
Utah Met. & Tunnel	0.35	0.25	0.29	December, 1927 0.30
MONTREAL				
Asbestos Corp	0.50	0.25	0.25	January, 1926 1.50
Asbestos Corp., pfd	1.37½	1.00	1.37½	January, 1930 1.75
Consolidated M. & S.	149	135½	135½	De. 30, Ja. 15, 1931 SAX 6.25

Company Name	High	Low	Last	Most Recent Dividend
SPOKANE				
Constitution	0.09½	0.05	0.07½	
Dayrock	1.25	1.00	1.25	March, 1930 0.03
Golconda	0.40	0.34	0.34½	July, 1929 0.02
Jack Waite Con	0.41	0.37½	0.39	
Los Lugos	0.06	0.02½	0.02½	
Mexican Premier	0.16	0.11½	0.15½	January, 1930 0.01
Montana Mines	0.13½	0.12	0.13½	
Noble Five	0.04	0.03	0.03½	January, 1930 0.005
Pend Orielle	0.77	0.52	0.70	
Sherman Lead	0.48	0.44	0.48	March, 1930 0.01
Sidney	0.09½	0.05	0.09	October, 1929 0.01
Sunshine Mining	1.35	1.15	1.17	December 20, 1930 Q 0.03
Tamarack & Custer	0.31½	0.28	0.30½	September, 1924 0.25
SALT LAKE CITY				
Chief Con	0.61	0.51	0.55	February, 1928 0.10
Combined Metals	0.10	0.09½	0.09½	
Eureka Bullion	0.24	0.17	0.23	
Eureka Lilly	0.25	0.19	0.21	
Moscow Silver	0.55	0.35½	0.40	
New Quincy	0.03½	0.03	0.03	Se. 20, Se. 30, 1929 Q 0.10
North Lily	1.20	1.02½	1.05	January, 1930 0.15
Park Bingham	0.00¾	0.00¾	0.00¾	
Park City Con	0.23	0.19	0.20	
Rico Argentine	0.03½	0.02½	0.02½	December, 1929 0.03
Silver King Coal	6.00	5.25	5.25	De. 20, Ja. 2, 1931 Q 0.15
Tintic Lead	1.10	1.05	1.07½	
Tintic Standard	4.30	4.00	4.05	De. 13, De. 24, 1930 Q 0.20
Walker Mining	1.72½	1.65	1.67½	April, 1930 0.075
TORONTO				
Abana Mines	0.23	0.14	0.14	
Amulet Mines	0.38	0.30	0.35	
Base Metals	0.17½	0.08	0.14½	
Barry-Hollinger	1.30	1.05	1.05	
Canam Metals	0.05	0.05	0.05	
Castle-Trethewey	0.22	0.18	0.18	
Central Manitoba	0.12	0.03	0.10½	
Falconbridge	1.62	1.33	1.52	
Howey Mines	0.38	0.25½	0.35	
Keeley	0.28	0.27	0.27	March, 1928 0.04
Kirkland Lake	0.80	0.55	0.73	
Lake Shore	26½	23½	25½	De. 1, De. 15, 1930 Q 0.30
Sherritt-Gordon	1.10	0.77	0.93	
Siscoe Gold	0.54	0.36	0.50	
Sylvanite	0.72	0.48	0.70	De. 5, De. 20, 1930 SA 0.02
Treadwell-Yukon	2.30	1.10	2.25	
Ventures	0.60	0.40	0.50	
Wipond Con	1.22	0.99	1.14	April, 1927 0.03
Waite A.-M.	2.00	1.70	1.75	
Wright-Hargreaves	2.30	1.90	2.25	No. 29, Ja. 2, 1931 Q 0.05
ST. LOUIS, CINCINNATI, AND DENVER				
Consolidated L. & Z	3.00	1.87½	1.87½	December, 1929 0.125
Eagle-Picher	5.75	5.00	5.50	April, 1930 0.20
Eagle-Picher, pfd			100*	De. 31, Ja. 15, 1931 Q 1.50
Empire Chief				
New El Paso				
Star of Utah				
Tungsten Prod				
SAN FRANCISCO, LOS ANGELES, AND COLORADO SPRINGS				
California Copper	1.00	0.50	0.75	
Golden Cycle				Fe. 28, Mh. 10, 1931 Q 0.40
Idaho-Maryland	0.37	0.24	0.37	
Portland				April, 1927 0.01
Tom Reed	0.80	0.55	0.75	December, 1926 0.02
United Gold				February, 1930 0.01

‡LONDON

Company Name	Metals Produced	Location of Properties	High	Low	Last
Anglo American	Holding	Various	14/—	10/—	11/10½
Aramayo Mines	Tin, bismuth, silver	Bolivia	20/7½	18/9	20/—
Burma Corporation	Lead, silver, zinc	India	8/11½	8/—	8/4½
Bwana M'Kubwa	Copper	Rhodesia	6/10½	5/8½	6/9
Camp Bird	Holding	Various	7d.	4d.	5d.
Fresnillo	Silver, lead, zinc	Mexico	8/3	8/3	8/3
Frontino & Bolivia	Gold	Colombia	9/6	8/3	8/9
Lake View & Star	Gold	Australia	11/7½	8/3	11/6
Mexican Corporation	Copper, zinc	Mexico	4/—	3/—	3/6
Oroville Dredging	Gold	California	2/—	1/8	1/6
Rhodes. Congo Border	Copper	Rhodesia	147/6	122/6	145/—
Rhodes.-Select. Trust	Copper	Rhodesia	20/—	15/—	20/—
Rio Tinto	Copper, pyrites	Spain	577/6	490/—	557/6
St. John del Rey	Gold	Brazil	18/3	16/7½	18/—
San Francisco Mines	Zinc, lead, silver	Mexico	14/7½	12/9	13/3
Santa Gertrudis	Silver, gold	Mexico	9/—	7/3¾	7/9
Selukwe	Holding	Africa	3/3	2/7½	3/—
So. American Copper	Copper	Venezuela	2/1¼	1/9	1/10½
Tanganyika	Holding	Africa	27/9	24/—	26/6
Wiluna Gold	Gold	Australia	16/7½	14/6	16/6
Union Minière	Copper	Bel.Congo	6,375	5,540	5,850†

Salt Lake Stock Exchange courtesy J. A. Hogle & Company, Spokane Standard Exchange courtesy the Pohlman Investment Company. *Not traded in †Belgian Francs. ‡The above London quotations are for the month ended Jan. 23. Q, quarterly; I, initial; M, monthly; X, extra; SA, semi-annual; L, liquidating